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Curriculum Guide

for

Elementary School

Science

(INTERIM)

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Department of Education

Edmonton, Alberta

September, 1968

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NOTE

Material for Conceptual Schemes D, E, F, will be forwarded later in the school year.

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NOTE: This curriculum guide is a service publication only. The official statement regarding the course is contained in the Elementary School Program of Studies. The information in the Guide is prescriptive in so far as it duplicates that contained in the Program of Studies. The Guide contains, however, as well as content, methods of developing the concepts, suggestions for using teaching aids and additional reference books.

AN APPROACH TO THE TEACHING OF SCIENCE

NATURE OF SCIENCE

A modern science program emphasizes inductive modes of inquiry. Contrasted with much science teaching in the elementary school, which has treated science as dogma, the change is marked and radical. In a large sense, the difference stems from one's definition and view of science. In oversimplified terms, if science is regarded as an accumulation of facts about the world, then it is defensible to design curricula with the goal of creating the most efficient scheme for teaching these facts. If on the other hand, science is regarded as an active process for acquiring knowledge about the world, curricula must be designed to bring the learner into a direct encounter with this process. The substance of inductive inquiry must be data; data and concepts are essential ingredients in inquiry. However, they are not the totality of science; processes of inquiry must be included and balanced against content in importance.

In today's elementary school science program, according to Brandwein (1965, p. 29), "Inquiry is a mix of human activity in search of meaning"! It thus involves the student, no less the teacher, in an active process. Teacher recitation followed by student absorption and feed back are seen to be antithetical to the processes of inquiry given support in this Curriculum Guide. Science is at one and the same time a body of knowledge and a process of inquiry.

References:

- Brandwein, Paul F. *Substance Structure, and Style in the Teaching of Science*. New York. Harcourt, Brace, 1965.
Essay on Structure and Art of Investigation, and the Art of Teaching.

OBJECTIVES OF SCIENCE

The new elementary school science program has two fundamental but inseparable objectives. By emphasizing the development and use of inquiry skills as tools of investigation, the program is designed to enable the student to become an active and dynamic investigator of science. To have the student develop basic science concepts is a second aim. A number of concepts, that is abstract ideas generalized from particular experiences, are to be developed under each of the six major conceptual schemes (refer to page 9) which provide a framework and structure for the program at each grade level.

Objectives

1. Skills

As a result of science instruction, the elementary school pupil should:

- (a) develop the ability to inquire, i.e. ability to think and investigate science through the use of process skills (behaviors) such as observing, classifying, communicating and inferring.
- (b) demonstrate manipulative skills in the use of apparatus in order to conduct investigations.

2. Attitudes

Much of the spirit and meaning of science is transmitted to students from the teacher. The teacher must create conditions of learning that will enable the student to:

- (a) demonstrate a growing curiosity and interest
- (b) demonstrate intellectual honesty
- (c) be open-minded

- (d) look for cause-effect relationships
- (e) suspend judgment when data is inadequate.

3. Concepts

As the student proceeds through the elementary school science program, he should develop an increasing body of scientific information in the form of concepts.

A more detailed discussion of conceptual schemes and process skills is to be found under the section, "Structure of the Curriculum," which follows.

STRUCTURE OF THE CURRICULUM

Structures in terms of this curriculum guide refer to conceptual schemes stated on a high level of generality to concepts and subconcepts and to processes of science stated in specific and detailed terms. The overall structure of the curriculum guide is outlined in terms of conceptual schemes that include key concepts of basic importance. The guide offers a list of six conceptual schemes (generalizations) and twelve basic processes of science to serve as guides for overall planning. Both the products of science (concepts) and processes of science (methods of inquiry) are included.

Conceptual Schemes

- A. When energy changes from one form to another, the total amount of energy remains unchanged.
- B. When matter changes from one form to another, the total amount of matter remains unchanged.
- C. Living things are interdependent with one another and with their environment.
- D. A living thing is the product of its heredity and environment.
- E. Living things are in constant change.
- F. The Universe, and its component bodies, is constantly changing.

Science is not simply a matter of accurate and detailed descriptions of things and events, or of extending our senses by the use of microscopes, telescopes, radar, etc. These are merely steps to a much larger objective: the invention of models or theories which ultimately form the bases for all explanations in science.

Several new elementary school science programs have been based upon conceptual schemes or very generalized theories. The facts and even many of the concepts will need to change with each advance in our understanding of the world. For this reason, it is difficult to forecast with precision what scientific content the child should know. A knowledge

of the basic findings of centuries of scientific inquiry gives boundaries and direction to the pupil's active investigation of his world.

Six basic ideas or conceptual schemes pervading ideas cut across most of the natural science disciplines are part of the structure of the new science program.

The pupil progressing through school should know as much as he can actively seize about each conceptual scheme in terms of his increasing intellectual power. For example, the pupil will progress toward an understanding of the following unifying ideas:

THE CONSERVATION AND TRANSFORMATION OF ENERGY (Conceptual Scheme A); the electromagnetic spectrum, energy of motion and potential energy, electrical energy and chemical energy; force and work, gravitational and magnetic fields.

THE INTERACTION BETWEEN LIVING THINGS AND THEIR ENVIRONMENT (Conceptual Scheme C); animal and human behavior, the relation between biological structure and function, the relationship of structure, color, etc., to the organism's environment and the necessity of the environment providing the conditions for the organism's survival.

Conceptual schemes help us to account for our experiences with nature. The wider their range of application, the stronger is our belief in their validity. This is not to say that conceptual schemes are infallible; they are subject to almost the same uncertainties as any other of man's ideas. But those that persist after being subjected to the test of time, including the repeated challenges and refinements by competent critics, become the foundations or the moorings of science.

A STRUCTURE FOR THE ELEMENTARY SCHOOL SCIENCE CURRICULUM

	CONCEPTUAL SCHEME A	CONCEPTUAL SCHEME B	CONCEPTUAL SCHEME C	CONCEPTUAL SCHEME D	CONCEPTUAL SCHEME E	CONCEPTUAL SCHEME F
CONCEPT LEVEL VI	Energy may be transformed; it is neither created nor destroyed. (Total sum of matter and energy is conserved; see "Conceptual Scheme B, Concept Level VI".	Matter may be transformed; in chemical change matter is neither created nor destroyed.	Living things interchange matter and energy with the environment (and with other living things).	A living thing is the product of its heredity and environment.	Living things are in constant change.	The universe is in constant change.
	Energy obtained from a machine does not exceed the energy put into it.	In nuclear reactions, matter may be destroyed to release energy. (The total sum of matter and energy is conserved; see "Conceptual Scheme A, Concept Level VI".	Living things are adapted by structure and function to the environment.	The characteristics of a living thing are laid down in a genetic code.	Changes in the genetic code produce changes in living things.	Nuclear reactions produce the radiant energy of stars.
CONCEPT LEVEL V	Once an object is in motion, it tends to remain in motion, unless energy is applied to produce an unbalanced force.	In a reaction, the totality of matter remains constant.	The capture of radiant energy by living things is basic to the maintenance and growth of all living things.	The cell is the unit of structure and function; a living thing develops from a single cell.	Living things have changed over the ages.	Universal gravitation and inertial motion govern the relations of celestial bodies.
CONCEPT LEVEL IV	Molecular motion can be altered by the absorption or release of energy.	Matter consists of elements and compounds.	Living things capture matter from the environment and return it to the environment.	A living thing reproduces itself and develops in a given environment.	The earth is in constant change.	The motion and path of celestial bodies is predictable.
CONCEPT LEVEL III	Energy can be changed from one form to another.	Matter exists in small particles.	There are characteristic environments each with their characteristic life.	Plants and animals reproduce their own kind.	Organisms are related through structure.	There are seasonal and annual changes within the solar system.
CONCEPT LEVEL II	There are different forms of energy.	Matter can change its state.	All living things depend on the environment for the conditions of life.	Related living things reproduce in similar ways.	Forms of living things have become extinct.	There are regular movements of the earth and moon.
CONCEPT LEVEL I	Energy must be used to set an object in motion (i.e., when work is done).	Matter exists in various states.	All living things are affected by their environment.	Living things reproduce.	There are different forms of living things.	There are daily changes on earth.

Process Skills (Methods of Inquiry)

In a new program called SCIENCE: A PROCESS APPROACH (AAA, 1965), processes of investigation have been identified and defined in detail. Each process is believed to be a basic intellectual activity of scientists that can be used in studying content. The proponents of the process approach point out that the content approach leads to an over-emphasis on information, requires too much time and effort, and may fail to develop relationships among concepts. They argue that, instead of being structured around such concepts as force and energy, the program should be built around processes such as observing and measurement, which can be applied to force, energy, matter and a host of other concepts. While this curriculum guide gives recognition to the importance of these processes, it does not emphasize the development of process skills for their own sake. Rather, the process skills should be developed and used as they are required by the student to gain and process data in order to develop concepts. The intent is that the teacher will develop a balanced program where process and content receive equal emphasis.

Basic Processes

Twelve process skills are outlined in the following pages. Some of these skills or processes are introduced in the early grades and continued in later grades.

Process

Example Activities

Observing

The desired pupil behavior is increasing competence in using not only his sense of sight but also his other senses of hearing, touch, smell and taste.

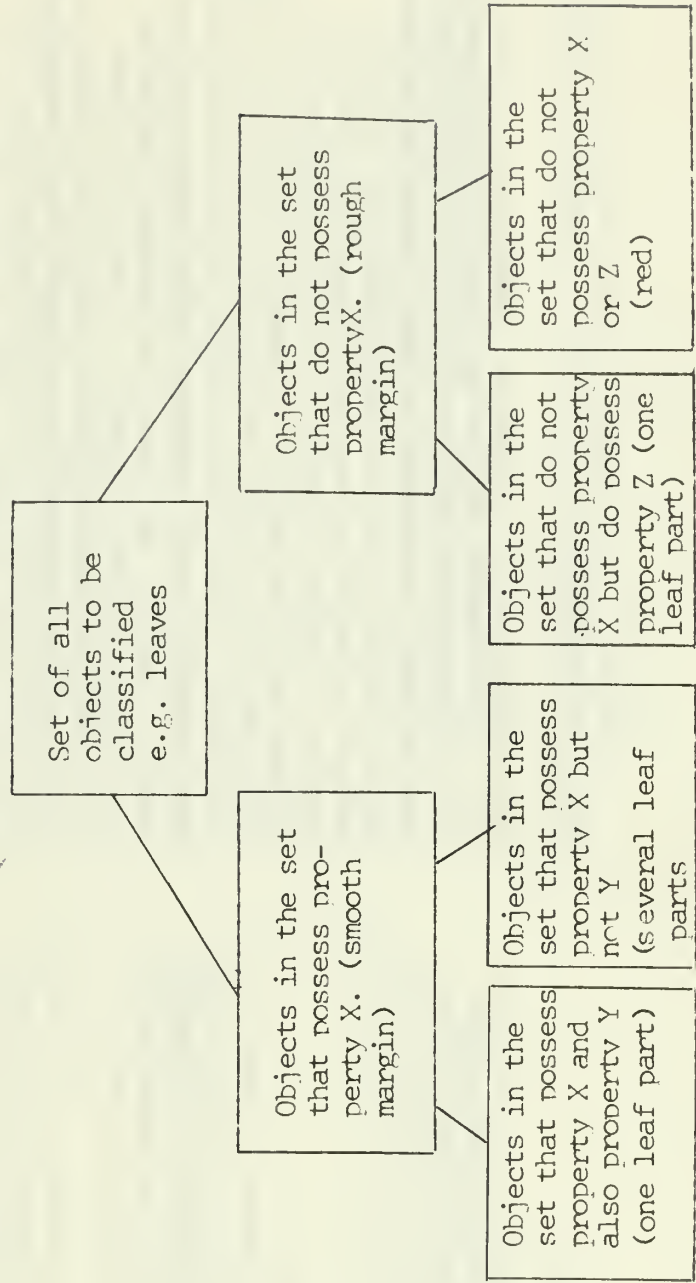
These may involve both oral and written descriptions of the following: Identify and name colors, textures, relative sizes and other properties of objects. Distinguish differences in temperature, read temperature on a thermometer; identify and name factors in weather such as temperature and precipitation; identify possible causes of change, such as heat, wind and air pressure, show the effect or cause of change on an object such as a balloon; describe selected items so that others can identify and name them; identify and name the main parts of a plant; describe plant growth over a period of time; describe the relationship between two variables.

Classifying

The desired pupil behavior is increasing competence in grouping articles, objects and ideas on the basis of some observable property or properties.

Objects may be classified according to smoothness, texture, color, and special characteristics. Single stage classifications are followed by two-stage and multi-stage classifications, as shown in the following illustrative sequence.

Two-stage Classification System



<u>Process</u>	<u>Description of Behavior</u>	<u>Example Activities</u>
Quantifying	The desired pupil behavior is increasing competence in measuring length, weight, area, volume, and rate of change of the physical world.	The following are illustrative: Distinguish objects by using such terms as heavier and lighter; identify relative weight by lifting; use a balance to distinguish heavier from lighter objects; use standard units of weight; explain effects of gravitation and inertia; measure the weight of various objects; describe differences in weight; identify, state and demonstrate differences in perception of weight.
Communicating	The desired pupil behavior is increasing competence in describing an experiment so that an individual who has not seen it can carry it out.	Experiences in identifying and naming objects are followed by graphing and describing measured changes as shown in the following example: Identify and name events that can be quantified, such as five bounces of a ball; make a column in a bar graph to represent the frequency of an event; distinguish events shown in a graph; make a bar graph; describe measured changes in speed, temperature, and other properties; make a prediction on the basis of recorded measures; make a graph to show the prediction; describe an experiment so that others might do it.
Inferring	The desired pupil behavior is increasing competence in drawing more than one inference from a set of data, demonstrating that inference can be tested by further observation, and demonstrating that an inference can be tested by applying known tests to the properties of objects. Pupils should indicate that they are able to distinguish between observations and inferences.	The following sequence is illustrative: Use the concept "evaporation" to explain how water is lost by plants; demonstrate a way to measure the water used by a plant; infer and demonstrate that water drawn through plants is transferred to the atmosphere; show that an inference may be tested by additional observations.

<u>Process</u>	<u>Description of Behavior</u>
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Predicting	The desired pupil behavior is increasing competence in conducting experiments to test predictions of relationships between two measurable quantities.
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Integrated Processes

Six integrated processes that build upon the basic processes are indicated in the following table:

<u>Process</u>	<u>Description of Behavior</u>
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Formulating Hypotheses	The desired pupil behavior involves developing increasing competence in stating a hypotheses regarding causes of a phenomenon or the relationship between two variables. A hypothesis tells how to observe an expected outcome of an experiment.
------------------------	--

Making Operational Definitions	The pupil should demonstrate increasing competence in stating the minimum things to do or look for in order to identify the subject being defined.
--------------------------------	--

Controlling and Manipulating Variables	The desired pupil behavior is increasing competence in arranging conditions so as to be able to deliberately control and manipulate objects or conditions in an experiment.
--	---

Example Activities

Various tasks might include: plotting data, making and interpreting graphs, and observing from different vantage points. For example, analyze a graph to determine the pattern of relationships (increasing, decreasing, stable); use a graph to predict water loss from plants; make predictions from a series of observations by means of graphs; conduct an experiment to test predictions.

Example Activities

The following illustrate hypotheses:

1. If the air pressure inside the tube is less than the air pressure outside the tube, then the water will rise in the tube.
2. If a ball is dropped, its speed will increase as it approaches the floor.

The following are illustrative: Cold means 15° C for this experiment; little friction means that not more than an additional 10% of force over and above the weight of the object is required to move the objects across a surface.

The following examples are illustrative:

1. Consider two pendula swinging at different rates. Variables to control might include: the weights, (size, shape, and mass), the string (length and thickness), and the length of swing.
2. Metals expand when heated. Variables to control might include: temperature of flame, nature of materials, wind, etc.

Process

Description of Behavior

Example Activities

Interpreting
Data

The desired pupil behavior is increasing competence in getting the most out of data without oversimplifying, drawing conclusions supported by the data, and considering alternative explanations.

Interpretations may be made of observations made in the form of verbal statements, graphs, histograms and tables.

Formulating
Models

The desired pupil behavior is increasing competence in building both physical and mental models to account for phenomena.

The following models are illustrative:

1. Pictures of the moon's surface
2. Diagrams of the life cycle of an insect
3. Physical model of a chromosome
4. Mental model - idea of an atom

Experimenting

The desired pupil behavior is increasing competence in planning, conducting and communicating experiments in which the problem is clarified, hypotheses are stated, observations are made, and data is interpreted. This process depends upon the pupil being able to use all of the other processes.

Pupils might develop experiments to answer the following questions:

1. How do mealworms react to light?
2. How many nails can a magnet lift?
3. What happens to salt when it is placed in water?
Does more salt dissolve in water at 35° C than at 20° C?

PUPIL EVALUATION

In elementary school science, as in other subjects, the teacher is concerned with how well she is teaching. One measure of her success is the nature and extent of pupil growth toward attainment of the objectives and development in those aspects of science which are being emphasized in the program. To obtain reliable evidence of the nature and rate of this growth on a regular basis, a carefully planned program of evaluation is essential. Such a program can serve a number of specific purposes by assisting the teacher to:

- make wise choices about what to teach and how to teach
- obtain information to diagnose individual pupil's problems
- gather sound evidence for the purpose of decision making in grading and grouping pupils.

The objectives of the present elementary science course must form the basis on which the teacher plans the evaluation of pupil growth. The stated objectives are the development of:

1. Skills a) Process - observing, classifying, communicating, inferring, predicting...
 b) Motor - handling apparatus, performing experiments
2. Attitudes - developing a growing curiosity, being intellectually honest, being open-minded, seeing cause-effect relationships, suspending judgment.
3. Concepts - developing an increasing body of scientific information meaningfully organized around large conceptual schemes.

The only one of these three objectives which has been stressed in the past is that of concepts - a body of scientific information. This objective has been evaluated by pencil and paper tests, either teacher-made or standardized, stressing almost exclusively recall of memorized information. If the new approach in science is to succeed, a radical change in evaluation procedures is essential.

The evaluation of skills and attitudes can be accomplished effectively through observation and the keeping of anecdotal records. As the teacher observes pupils involved in doing science she can make brief notes concerning how skills and attitudes are developing or changing in individual pupils.

She can also use a check list similar in format to the one illustrated. The kinds of categories she uses will be her own choice but some of the following seem useful in evaluating skills.

	Observing	Classifying	Quantifying	Communicating	Inferring	Predicting	Formulating hypotheses	Defining terms	Controlling variables	Interpreting data	Formulating models	Manipulating equipment	Performing experiments
Mary Joyce													
Willy Nilly													
Peter Piper													

The use of such a check list presumes extensive pupil involvement. If such involvement is lacking, any meaningful use for such a check list does not exist.

A similar type of check list can be used in evaluating attitudes. The following categories should be useful as suggestions but are illustrative only.

	Developing curiosity	Demonstrating intellectual honesty by: saying "I think"	Admitting mistake	Admitting he did not know	Consulting authority	Demonstrating open mindedness by: changing opinion	Using more than one source	Avoiding jumping to conclusions
Mary Joyce								
Willy Nilly								
Peter Piper								

To evaluate the development of concepts requires a variety of approaches. Some recommended types of tests are:

Objective Tests

Objective tests permit extensive sampling of topics covered and include the short-answer type, the completion type, the true-false type, the multiple choice type and the matching type. They are easily and quickly scored but usually tests only recall of factual information.

Essay Tests

While essay tests cannot sample as extensively as objective tests, they have the advantage of providing the opportunity for students to demonstrate the degree to which they can analyze, select relevant information, present evidence and organize answers logically and effectively. The effectiveness of this type of test is increased if the students are required to use knowledge in situations which have not been used in class. Essay items should measure the ability of pupils to apply principles, recognize relationships, and make generalizations.

The Art of Questioning

Teachers can lead students into all kinds of thinking through careful use of high quality questions. While some teachers intuitively ask superior questions, many over-emphasize those that require students only to remember ideas rather than to use ideas.

A very useful classification of questions has been developed by B. S. Bloom. By first classifying educational objectives and thinking processes into categories that were meaningful with on-going work of the classroom, Bloom was then able to define categories of questions which were useful to the teacher in teaching and in evaluating. A very brief summary of Bloom's categories of thinking is as follows:

- | | |
|--------------------|---|
| 1. Memory: | The student recalls or recognizes information. |
| 2. Translation: | The student changes information into a different symbolic form or language. |
| 3. Interpretation: | The student discovers relationships among facts, generalizations, definitions, values, and skills. |
| 4. Application: | The student solves a life-like problem that requires the identification of the issue and the selection and use of appropriate generalizations and skills. |
| 5. Analysis: | The student solves a problem in the light of conscious knowledge of the parts and forms of thinking. |

- 6. Synthesis: The student solves a problem that requires original, creative thinking.
- 7. Evaluation: The student makes a judgment of good or bad, right or wrong, according to standards he designates.

The teacher who has learned this taxonomy of questions and applies it can improve the intellectual climate in his classroom. Not only will he realize the importance of each category of question but he will also be seeking opportunities to employ a greater variety of questions in order to develop each student's ability to use all the categories of thinking of which he is capable. It is not enough for a student to be able only to recall information, he should learn to translate, interpret, apply and so on. Only as the result of expert teacher guidance and direction will these higher types of thought processes be encouraged.

References:

Sanders, Norris M., *Classroom Questions, What Kinds?* Fitzhenry and Whiteside Ltd., 1590 Midland Avenue, Scarborough, Ontario.

Bloom, B. S., *Taxonomy of Educational Objectives: Part I The Cognitive Domain*, Longmans Canada Ltd., 55 Barber Greene Road, Don Mills, Ontario.

CONCEPT FORMATION

One great weakness of current science teaching seems to be an almost exclusive reliance on textbooks, the teacher, and other such authoritative sources of information. These sources for science learnings as they facilitate the development of concepts, are quite important compared to direct physical experiences.

A highly diversified program based heavily on direct physical experiences, but reinforced by the use of films, filmstrips, non-projected materials and discussion is essential to readiness for most concepts. It is important that experiences with real things be presented within a conceptual framework. Then, and only then, will early learnings form a base for the assimilation of experiences that come later--experiences that may involve either direct observation (using all the senses) or verbal and pictorial reports of observations made by others. Lavatelli, on pointing up the importance of the laboratory approach states:

Piaget has written of the dangers of premature verbalization; he maintains that the child can receive valuable information via language only if he is in a state to understand the information. In science, direct physical experience, either through demonstration or experimentation, is essential to readiness for most concepts in the curriculum. Furthermore, the learner needs the opportunity for corrective feed back gained in interaction with his peers as well as his teacher. Such experiences of concrete manipulation and interaction with classmates are provided in the laboratory approach.¹

In performing investigations with new phenomena, the children are confronted with evidence which contradicts what they presently believe. It is through laboratory-type experiences that erroneous concepts can be challenged and the learner readied to acquire new knowledge.

Conceptual Formation

A concept is a gradually developing, never ending verbal and mental image which is unique to each person at any time. Concepts are not taught directly by the teacher, but rather, are the result of mental and physical activity on the part of each student.

¹ Cecilia B. Lavatelli, *Individualization Through The Laboratory Approach*, *Science Curriculum Improvement Study Newsletter*, No. 12, vol. Spring 1968.

THE ROLE OF THE TEACHER AND OF THE STUDENT

The inquiry approach will, for some teachers, require a different way of teaching. Their role will shift from that of dispensing facts and information to providing children with opportunities for discovering this knowledge for themselves. It is vital that pupils have many opportunities for active physical and mental exploration with materials and equipment.

In this program, it is important for you as a teacher to encourage your students to question and wonder about things. Allow enough time in your schedule for the children to plan and to carry out investigations and to find answers for themselves. Do not feel pressured to "cover" a great deal of information, but instead, permit the children sufficient time to develop basic science understandings.

A concept can often be introduced by confronting the class with a problem, the solution for which the children have to apply previously learned concepts and process skills. Give the children an opportunity to develop their own theories. When children suggest theories or "guesses" as possible solutions, do not be too quick to indicate whether the suggestions are right or wrong. A possible general teaching strategy might involve the following.

As teacher, you should assume the role of an attentive listener and assist the children to be more self-sufficient. You should expect that your children will make mistakes. When your students make mistakes, help them to analyze where they went wrong and guide them (not tell them) toward a more suitable explanations. Many scientific discoveries are made in laboratories where a spirit of exploration is maintained. Similarly, if a climate of inquiry is carefully nurtured in the classroom, science learnings can be broadened and enriched. In keeping with this spirit, allow extra time for experiments and demonstrations that may not work out on the first try. Be sure to give the children the right to make mistakes - and the time to correct them.

As children work toward finding solutions to their problems not only is it important for them to acquire the products of scientific investigation (the concepts and/or theories), but it is also important for them to use the processes of science. Note that for each suggested activity in this guide certain process skills are emphasized which can be developed only through direct experience.

The discovery approach does not mean that you will allow the whims of the students to guide the science program. You will need to carefully

organize much of the instruction. Children should plan some of their own activities, but this should only be done within the overall organization of the science curriculum.

Recently there has been a trend away from teaching science by the problem-solving method. It has been recognized that scientists do not use one exclusive method for solving problems, but instead, use a variety of methods in their scientific work. It has also been recognized that the problems with which children are confronted in a science program can be solved without strict adherence to the five ordered steps of the problem-solving method.

Problems given to pupils by the teacher are often not vital. A problem is real to the pupil when he observes a situation which is in conflict with his existing understandings. From the problem situation the pupil will try to develop a theory or possible explanation. Investigation(s) involving the construction of hypothesis is (are) necessary. The hypothesis developed will be the result of using the information he has acquired from previous experiences.

Hypothesis, correct and incorrect, will come from clear insights and adequate interpretations, but only if children are encouraged to meet the challenge of unconventional learning.

The work of Suchman at the University of Illinois is an excellent verification of the belief that children can prepare and test hypotheses. There is no dearth of opportunity for training in good habits of logical thought if children are not restricted to dull memorization of the textbook. Children should have numerous opportunities to predict the results of a particular action. Do not supply the answer in advance, nor allow children to turn to authority before their own analytical schemes are found wanting or before additional verification is required. Continue to ask, "Why? How do you know? How can we test this? Are you sure? How can we find out? What will happen if we do what you say? What do we need in order to do it? Where can we find out? What do we do next?"

A permissive classroom atmosphere must prevail which encourages both children and teacher to examine the evidence they find, to assess their hypotheses, and to come to the most reasonable and logical interpretations of the data consistent with the evidence.

EXAMPLE: A Strategy for Teaching an Open-ended Problem Situation,
Upper Elementary.

CONFRONTATION

In introducing students to the concept, "Energy must be applied to produce an unbalanced force, resulting in motion or a change of motion," a burning piece of paper might be thrust into a milk bottle and then a peeled, hard-boiled egg placed on the mouth of the bottle without comment from the teacher. (The egg which is larger than the mouth of the bottle, is pushed through the mouth and "pops" into the bottle. This is the confrontation which provides the focus for the investigations which may take two or more periods) This activity may be done as a demonstration by the teacher or by pupils working in groups.

The pupil might make the following recordings in his book:

Observations:

This would include the actual things the pupils saw, not what they assumed happened. e.g. The pupil might record "Shortly after the egg had been placed on the mouth of the milk bottle which contained a piece of burning paper the egg began to "jump". (It may be necessary to do the activity more than once.)

Theory:

Have the pupils suggest theories to explain the happening. Pupils will suggest various theories as possible explanations. These theories might include the following:

1. The air in the milk bottle expanded when it was heated and some air escaped from the bottle. The air contracted again when it cooled. The contracted air occupied less space, and hence, the greater air pressure on the outside pushed the egg into the bottle.
2. The neck of the bottle expanded and therefore let the egg fall into the bottle.
3. Part of the air was burned out which left the air pressure on the outside greater than that on the inside so that the egg was pushed into the bottle.
4. The burning paper dried the egg out, thus making it smaller so that the egg fell into the milk bottle.

Since several possible theories have been developed that may serve as possible explanations, it now becomes necessary for pupils to develop investigations to check their theories. Pupils might then record under the headings given below. An example of possible pupil recordings is also given:

Problem:

What caused the egg to go into the bottle?

Hypothesis:

1. If the milk bottle is heated, the diameter of the milk bottle neck will expand and let the egg drop into the bottle. (Students either individually or in groups will need to test each hypothesis that is developed. A method of attack should be planned.)

Attack:

Measure the diameter of the milk bottle mouth before and after heating.

Observations:

	Temperature	Inside Diameter of Bottle's Mouth
Before Heating	70°F	1.5 in.
After Heating	83°F	1.55 in.

Interpretation of Data:

Since the inside diameter of the milk bottle mouth increased, it is possible that this helped to put the egg into the bottle.

EXAMPLE: A Strategy for Teaching an Open-ended Problem Situation,
Lower Elementary.

CONFRONTATION:

By using a magnet, have pupils pick up various objects such as tacks, nails, etc.. Then have them attempt to pick up a small piece of aluminum. All metals pupils picked up initially were attracted by the magnet. A confrontation (by means of a discrepant event) is provided when the magnet will not pick up the piece of aluminum. The pupil might record the following:

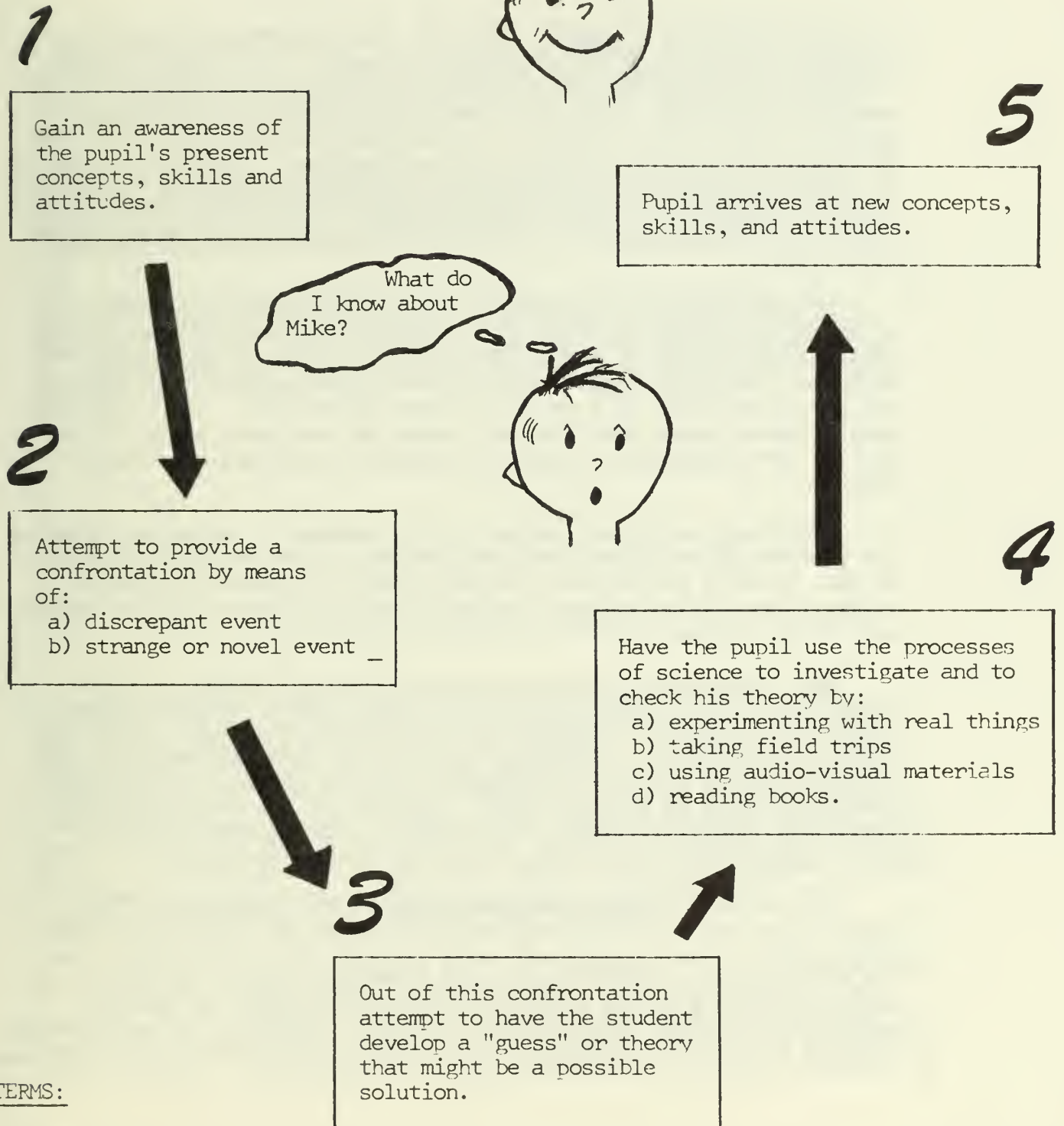
What I Saw: (Observation)

The magnet picked up the nail, paper clip, and tack but did not pick up the piece of aluminum.

What I Found Out: (My interpretation of what I saw)

A piece of aluminum is not picked up by a magnet.

A GENERAL TEACHING STRATEGY



TERMS:

CONFRONTATION:

recognition of an object or event that is new and/or contradicts present understandings.

DISCREPANT EVENT: a physical event that produces surprise and puzzlement and one that the pupil cannot readily explain.

PROVISIONS FOR THE INDIVIDUAL CHILD

The laboratory approach to science teaching offers special opportunities for achieving individualized learnings. The teacher must so structure the situation that the class is involved in an educationally meaningful situation, while the teacher works with the individual. When all children have available the equipment and materials which are essential parts of the laboratory science program, they will be involved in following suggested investigations, exploring interesting investigations, or discussing their findings with each other. Once this takes place, considerable progress has been made toward individualization of instruction.

In some instances, opportunity should be provided for every child to do the activities individually. However, in most instances, pupils should work together in groups of 2 or 3. The list of recommended equipment (available from Curriculum Branch upon request) is such that ten groups of pupils will be able to work at one time. There will be some instances where the class as a whole may work as a group. This will be particularly true where the teacher is carrying on a demonstration.

Pupils may be grouped randomly or by ability. The teacher, knowing the students in her class, can best determine which method is better to use. Some of the abilities you may wish to consider in grouping students are ability to lead, mechanical ability, and ability to record and interpret data.

When activities of an open-ended nature are provided where the objective is not to come up with one "right" answer, various degrees of thinking and levels of sophistication will develop depending upon the relative abilities of the pupils in the class. The teacher should not expect a uniform level of achievement in her classroom. Children will develop concepts at various levels. By studying the various concepts under each conceptual scheme, the teacher is able to see where the pupil's achievement places him on the "conceptual ladder".

Pupils who are free to inquire, explore and investigate often desire to go beyond the textbook to find answers to new problems that puzzle them, as well as to learn more in depth about the subject they are studying. The teacher serving as a resource person, can guide the pupils to explore varied means of acquiring knowledge. A teacher committed to inquiry teaching will not limit himself to one textbook but will use a variety of materials, both reading and concrete, real materials.

USE OF SCIENCE TEXTBOOKS

While three new series of textbooks have been approved for use in Alberta elementary schools, it is strongly suggested that no one science series should be used to the exclusion of the others or other library books. The texts should be used as references and should in no way constitute the science program.

It is strongly recommended that not more than 10 copies of any one series of textbooks be purchased for use in a classroom.. This would enable each group of three pupils to have one reference that it might wish to follow or consult when doing an investigation.

Normally direct experiences should come prior to having pupils read from textbooks or references. The science program must not be a read-about science. The science program cannot be taught effectively by using science textbooks alone. Other instructional materials must be used.

SCIENCE EQUIPMENT AND MATERIALS

Each elementary school should contain adequate equipment and materials in order that science may be experienced by the pupil as more than a mere "read and discuss" type of program. For too long a time, elementary school teachers have been expected to scavenge for necessary science materials. It is true that many items can be obtained from home; however, substitutes for some items are both hard to find and very time consuming for the busy teacher. A trend in elementary school science toward a greater emphasis on physical science brings new demands. Under the nature study program, science was taught descriptively. Few manufactured materials and equipment were required.

Educators are now concerned that the elementary science program must be considered as more than a body of content to be transmitted to the pupils. The program should foster a critical approach to the subject with an emphasis on experimentation and inquiry rather than the mere assimilation of facts. The teaching of science descriptively must be replaced by

a kind of teaching that demands a more questioning, inquiring attitude on the part of both students and teachers. Students who are led to discover for themselves are the ones who really catch the spirit of science and who really understand and develop the basic concepts, the "big ideas", and the process skills.

Good inquiry must be learned and practiced. This involves taking in and processing raw data in the mind and data provides the raw material from which pupils abstract concepts. Because elementary school pupils are going through a developmental stage (Piaget and Inhelder) when their thinking is tied mainly to real things, the laboratory approach to the teaching of science is most essential. Some of the very basic and fundamental ideas of science therefore, can be developed early in the elementary school by using a concrete approach. The environment for this pupil investigation and inquiry requires equipment and materials appropriate for children's use.

LENSES AND MICROSCOPES

The purpose for using a lens or microscope is to extend the students' powers of observations. The degree of magnification required depends upon the objects with which the student is working. Generally, students in elementary school will not require magnification beyond 100 power. Problems often occur when pupils try to locate objects under a microscope with magnification powers greater than 100. A microscope with 40x magnification will be suitable for most work.

Magnification Devices

NOTE: All prices are subject to change.

1. A piece of small gauge wire with a loop formed at one end dipped in water, can provide students with the basic idea of a lens when they are beginning their study of magnification.
2. Magnifying Lens - Magnification often ranges from 2x to 10x. Two lenses may be used to give magnification up to 20x.
3. Fresnel Lens Teaching Kit for Overhead Projectors - Projected images of such things as salt crystals and brine shrimp, daphnia, etc., can be magnified many times. The lens is available from:

Educational Products
C/O Minnesota Mining and Manufacturing Company
London, Ontario

Education Price - \$6.25

4. Simple microscope - Contains a single glass bead lens. Various powers of magnification; e.g.
 - 1) A. S. & E Microscope - available from McGraw-Hill. An economical little microscope (approx. \$3.50) with 90x and 180x (with attachment). Suitable for viewing small objects only.
 - 2) Mini-scope - available from Arbor Scientific Ltd., Box 113, Port Credit, Ontario. An economical microscope that sells for \$2.00. Suitable for small things only. Cannot be used with large objects such as pupa, larvae, beetles, etc.
5. Compound Microscopes - contains at least two lenses. Several good ones are on the market which are priced between \$15.00 - \$30.00.

Microscopes used by elementary school pupils should have general utility, be durable and easy for pupils to operate.

The A. S. and E. compound microscope, available October, 1968 (Approx. cost \$4.50) has the following advantages over the A. S. and E. single microscope described above: it offers increased working distance and focal length; facilitates observation of wet slides and larger specimens (which simple A. S. and E. doesn't). Magnification - 30x and 100x.

	Name of Microscope	Strengths and Weaknesses	Approximate Cost	*Distributors
a)	B & L Model ESM	Quite good quality resolution. Easy to operate. Recommended for use in Ontario.	40x - \$17.00 100x - \$19.00	C, W, S, R, M
b)	Blister Elementary Microscope	Built-in source, wide field, blister slides are very good for live specimens, resolution - good.	50x - \$29.00	AVS
c)	Swift Elementary Microscope	Zoom power or 10x eyepiece, very good resolution.	40x - 80x \$37.00	W
d)	Bushnell T60902-2 T60902-3	Very good resolution Very good resolution Good for use in elementary and Grade 7 Life Science.	40x, 60x, 100x 150x - \$32.00 100x, 150x- \$28.00	C C

	Name of Microscope	Strengths and Weaknesses	Approximate Cost	*Distributors
e)	Tasco #904	Long range focusing up to 20 mm, thick	100x - \$20.00	T
	#906	Very good resolution	50x, 100x, 300x - \$29.95	T
f)	Canlab Microscope S6030	Very good resolution. Very good for use in Elementary or Grade 7 Life Science.	50x, 75x, 100x, 150x, 400x, 600x - \$28,00	CL

* Key to Distributors:

C - Cenco	R - Raytheon	CL - Canlab
W - Welsch	A - Arbour Sc.	
S - Sisco	M - McCalaster	
T - Tasco	A. V. S. - Associated Visual Services	

Quantity discounts range up to 25%. Considerable savings could be made by purchasing microscopes on a division, county, or district basis.

Activities With Lenses and Microscopes

Beginning in Grade 1, many activities that give pupils opportunities to extend observation skills should be provided in a good science program. Activities might involve observing such things as; onion cells, sand, salt, pepper, cloth fibres, hair, micro-organisms, various insects and their body parts, molds, mealworms, feathers, and finger prints.

REFERENCES:

1. *Ward's Natural Science Curriculum Aids*
and
Ward's Natural Science Culture Leaflets

Available free of charge from:

Arbor Scientific Ltd.
Box 113,
Port Credit, Ontario

These aids are excellent for all aspects of Life Science.

2. Johnson, Gaylord and Maurice Blaifield, *Hunting With The Microscope*,
Sentinel Book Publishers, Inc., New York, New York

Available from: Cole's Book Store
Bonnie Doon Shopping Centre
82 Avenue and 83 Street
Edmonton, Alberta

3. *Turtox News* and *Turtox Service Leaflets* (free)
General Biological Supply House
8200 South Hoyne Avenue
Chicago, Illinois 60620

4. Gray, *The Use of The Microscope*
McGraw-Hill Company of Canada Limited
330 Progress Avenue
Scarborough, Ontario

THE USE OF LIVING THINGS

A science room equipped with plants and animals can become a laboratory for stimulating many investigations. When inquiry, observation, and experiments are encouraged, the giving of "ready-made" textbook answers is kept to a minimum. Young children learn to connect cause and effect and find out why certain things happen. Plants and animals stimulate speculation among pupils and lead them to the use of the process skills in conducting investigations.

It is strongly recommended that for teachers who wish to have plants and animals in the school, that the following leaflet be purchased:

*How to Care For Living Things in The Classroom*¹

Available from: The National Science Teachers' Association
Washington, D. C. 20036

Price: 35¢ (U. S. funds)
(Prices subject to change)

¹Adapted from: *How to Care For Living Things in The Classroom*. National Science Teachers' Association, 1965.

USE OF AUDIO-VISUAL AIDS

Audio-visual resources may be used to extend direct experience of children. It is never intended that these resources should take however the place of actual manipulation of materials. Teachers should use films, filmstrips and other similar materials depending upon the instructional function to be performed. For example, animated films may result in a visualization of molecular activity in solids, liquids and gases that may be superior to mechanical models. Or an 8mm. loop may be used to present a problem or stimulate experiments. In another context, materials such as filmstrips, 8 mm. loops and transparencies can be regarded as extensions of library resources to which children will have access.

The following points should be carefully considered when using audio-visual materials.

1. Know the purpose to be served by the materials. What learning outcomes do you expect from the experience?
2. Preview the materials.
3. Have a definite reason for using a particular resource or a particular technique at a particular time.
4. Introduce the material to the class or group in such a way that the purpose of the experience is clear.
5. Integrate the experience with the understandings being developed by careful follow-up.

An individual child or group can learn a great deal by investigating audio-visual media independently.

Non-projected materials such as charts, models and study prints or pictures can be used or more sophisticated media such as the following may prove useful:

16 mm. Films:

By their very nature films tend to be very highly structured. However, film makers have more recently been attempting to produce films which are much more open-ended. If the sound that something makes is

important, the narrator stops talking and lets it be heard. By utilizing the strengths of the film medium, several new films challenge children to think for themselves. Formerly, it was thought that a film should be shown from beginning to end. The teacher should not be afraid to stop a film in the middle if its pace is too fast. In any case, one segment may be all that is relevant. By using headphones connected to a distribution box which is plugged into the projector, a small group can watch and hear a film without disturbing the rest of the class.

8 mm. Film Loops:

8 mm. film, placed in a cartridge so that it will run continuously, has great potential for science teaching. Concepts demanding motion, such as chain reaction, metamorphosis and atmospheric re-entry, in their illustration can now be dealt with effectively. Film taken with a "home-movie" type camera can be loaded into a cartridge for a few dollars. In this way, school experiments can be recorded and filed for future use.

35 mm. Filmstrips and 2 x 2 Slides:

Filmstrips are excellent sources of pictorial information. The filmstrips format necessitates a fixed sequence of frames. There is no reason why any teacher should feel obligated to use all frames or to present them in the original order. 2 x 2 slides may easily be rearranged to provide the best sequence for the purpose. Pictures taken by teachers and students may be readily prepared in this form. Children could use their own slides to record and present some significant activity.

A carefully chosen slide can often provide children with much information and elicit many questions.

The Overhead Projector:

The overhead projector can readily be adapted to a variety of teaching techniques and individual class situations. Transparencies to illustrate important science concepts may be prepared by the teacher or produced from commercially prepared "masters".

The outlines of opaque objects can be shown. This fact makes it possible for example, to place a magnet on the projector's stage, sprinkle iron filings on an acetate sheet and let the students observe what happens. An extra fresnel lens can be used to project and magnify a variety of objects, such as live pond specimens in vials, salt crystals, etc. Slides may also be projected in this way.

School Broadcasts:

Each school year a number of radio and television programs are presented which can be of help in developing the science program. Every teacher receives a schedule of these programs in September which also give times and stations.

Audio Tape and Records:

If a radio broadcast comes at a poor time for class use, it can be recorded and re-played when needed. Programs from other years are available for copying on the school's blank tape by the Audio Visual Services Branch, Department of Education. Actual recordings of sounds can be made by the teacher or pupils for class use.

Closed Circuit Television Equipment:

If the school is equipped for T.V. a number of exciting possibilities are open to the enterprising science teacher. Television programs can be recorded and used in class at the appropriate time. Difficult and dangerous experiments can be demonstrated for the television camera and shown to students at a later time. The television camera will magnify objects so that the whole class can see without crowding around the teacher's desk. Demonstrations with rare or costly materials can be performed once and the video-tape re-shown many times.

Addresses of Audio-visual Suppliers

The teaching suggestions for each conceptual scheme list a number of films and filmstrips for classroom showing that are available from the following suppliers of distributors.

Producer

Academy

Cenco

Distributor

Academy Films
748 N. Seward St.
Hollywood 38, California

C/O Eye Gate House Inc.
447 Tinniswood Street
Winnipeg 14, Manitoba

Producer

Distributor

Coronet

Sovereign Film Distributors Ltd.
277 Victoria Street
Toronto, Ontario

Curr.
(Curriculum Films)

Mr D. C. Lofquist
Instructional Materials Center
Suite 1510 - 10145 - 121 Street
Edmonton, Alberta

E. B. F.

Encyclopaedia Britannica Films Ltd.
c/o Mr. Roy Sherwin
9719 - 84 Avenue
Edmonton, Alberta

E. F. D.

Educational Films Division
John Colburn Associates
1122 Central Avenue
Wilmette, Illinois 60091

F. A.
(Filmstrip House)

Carman Educational Association
Box 64
Pine Grove, Ontario

F. O. M.

Filmstrips of Canada
3333 Metropolitan Boulevard, East
Suite 301
Montreal 38, P. Q.

Gateway

Carman Educational Association
Box 64
Pine Grove, Ontario

J. H.
(Jam Handy)

Jam Handy Company
c/o Mr. Gordon E. Watt
15 Ferbane Place
Willowdale, Ontario

McGraw-Hill

McGraw-Hill Co. of Canada Ltd.
(Text Film Department)
330 Progress Avenue
Scarborough, Ontario

Producer

Distributor

N. B. F.

National Film Board
Box 6100
Montreal 3, Quebec

S. V. E.
(Society of Visual Ed.)

Educational Film Distributors Ltd.
191 Eglinton Avenue East
Toronto 12, Ontario

Walt Disney

Encyclopaedia Britannica Films Ltd.
c/o Mr. Roy Sherwin
9719 - 84 Avenue
Edmonton, Alberta

Y. A. F.
(Young America Films)

McGraw-Hill Co. of Canada Ltd.
(Text Film Department)
330 Progress Avenue
Scarborough, Ontario

Y. L. P.
(Your Lesson Plan)

Mr. D. C. Lofquist
Instructional Materials Center
Suite 1510 - 10145 - 121 Street
Edmonton, Alberta

Symbols Used For Audio Visual Materials

Film ⏮

Filmstrip ⏮

Tape ●—●

Record Ⓢ

Slide []

SCIENCE FACILITIES

A Science Room

Ideally, a science room of 1,200 square feet should be provided and equipped with plenty of flat surfaces on which to work, electrical and water outlets, means of easily darkening, adequate sources of references, ample display and storage space. Flexibility is an essential quality of a room for science. Rearrangement of the room must be possible with a minimum of effort and confusion. Children themselves should be able to easily find whatever they need for their investigations. This helps them to become more self-reliant and reduces the routine demands on the teacher.

Some Possible Ways of Organizing Your School For Science

1. Science rooms to which pupils move for their science classes.
2. Self-contained classroom making use of mobile carts with tote-boxes. (Plans for mobile carts will be supplied by the Curriculum Branch upon request). This might be desirable for Grades I and II.
3. Self-contained classrooms with adequate equipment for each room. (This is very costly.)
4. A combination of two or more of the above.

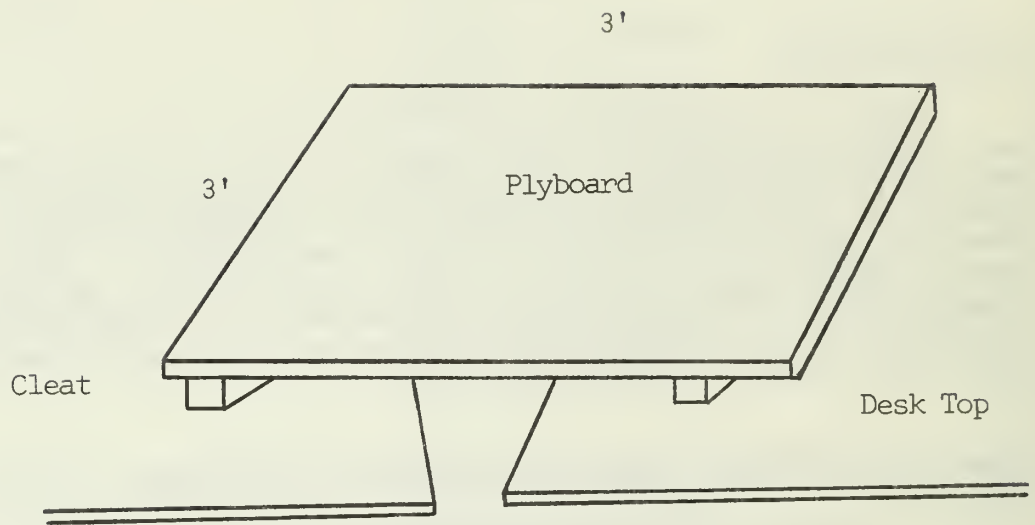
Materials and Equipment Should be:

1. Easily accessible to both teachers and students.
2. Kept together by using tote-boxes or some other similar device or by having it all in a science room.

Large Flat Top Surfaces Upon Which Pupils May Work is Essential

These may be provided by:

1. Moving flat top desks together.
2. Using sheets of 3' x 3' plywood with two cleats on one side and placed on sloping desk tops.



3. Using tables, either rectangular or trapazoidal.

PLANNING A FIELD STUDIES PROGRAM

A major goal of science teaching is to devise instructional activities and procedures that will improve the effectiveness of science teaching. In this Guide, inquiry, discovery, and investigation receive major emphasis at all grade levels. In accord with this new emphasis from telling to inquiry, from "show and tell" to investigating, from discrete facts to understanding concepts, field studies assume new meaning and importance.

How to Plan a Field Study:

Choose a field study when it is the best investigational method available for the desired type of learning outcome. In science classes, this usually means when first-hand experiences beyond the confines of the school building cannot be provided as effectively in any other way.

A field study is justifiable when it is a planned learning experience conducted with clearly defined purposes, preferably closely related to class activities. A class is ready for a field study only after appropriate problems are defined and the probable sources of data enumerated. Without such pre-planning a field study trip will result in random observations.

- a) Preparing a Field Study Outline - A study outline is frequently used as a means for increasing the effectiveness of a field study. The study outline should contain: a short description of the problem, the questions to be resolved, and the observation to be made. It should identify what is to be accomplished and enumerate what responsibility the student has for each activity. It may suggest data to be assembled, processes to be observed, or specimens to be collected.

It may also include data charts for the convenience of recording observations. Maps of routes showing points for observation and diagrams of resource sites may be useful. A list of essential equipment, supplies and special instructions form a part of this outline.

- b) Choosing a Resource Site - Selection of the resource site should be made in terms of specific criteria which might include such things as the following: the possibility of seeing a scientist at work, the convenience of the site to the school, the chance to correlate science with other school subjects, and

opportunities for students to make use of knowledge for interpreting a wide range of conditions and phenomena.

- c) Assigning Responsibilities to a Conductor - The teacher should determine in advance whether he must assume the responsibilities for preparing and serving as a conductor or if such a person will be provided at the resource site. The teacher should provide the conductor with an outline of what the class wishes to know, the questions that may be asked, and some idea of the science background and maturity level of the students.
- d) Making Arrangements for the Use of the Site - Certain mechanical details such as the following must be attended to: Should all students visit the site? How much supervision will be required? When is the best time of the day or year to visit the site? How much time will the visit require? What points on the way to the site are of special interest? How should the class be organized?
- e) Checking Details - Arrange permission and transportation well in advance of the trip. Send home parent permission forms and check returns. Send a copy of the study outline to any adults who are to assist with the trip. (Don't forget your school board.) Confirm with those in charge of the site, three days before you visit, that you will be arriving on schedule.

Student committees might well determine such things as: suitable dress, accessible equipment, behavior standards, safety rules, mark out the itinerary on a map showing special points to be observed.

- f) Following-up - Some specific purposes of the field follow-up might be :
 - i) to obtain reports from the various committees on the data gathered so that information may be shared, interpreted, clarified or appraised.
 - ii) to organize and review the ideas and materials gained by oral or written reports, bulletin board displays, demonstrations, worksheets, discussions, use of photographs, tests or identification of specimen materials obtained on the trip. Each student should have some responsibility in interpreting what he saw and explaining what it means.

- g) Evaluating - The teacher will attempt to determine the degree to which her purposes for taking the field study were met. Evidence might include having pupils complete a "Field Study Evaluation Form", student prepared booklets, and evidence that might be collected to support the general objectives of elementary school science.
(See - Pupil Evaluation)

GRADE I

CONCEPTUAL SCHEME A

When energy changes from one form to another, the total amount of energy remains unchanged.

SUGGESTED MATERIALS AND EQUIPMENT

electric clock, record player, damaged record, gasoline-powered model airplane, balloons, string, plastic boat, pan, aluminum foil, small wagon, toys, doll carriage, elastic bands, dinky cars, steel balls, cardboard box, block or wood, sandpaper, magazines, fork, rotary egg beater, construction set of matchbox series or similar, single pulley, twine, blocks, balls, chair, wide-mouthed jars, food coloring, washers, magnets, thumb tacks, seeds, pennies, tin cans.

RECOMMENDED REFERENCES

Code: C.I.S. - *Concepts in Science* (Longmans)
S.M.A. - *Science, A Modern Approach* (Holt, Rinehart)
S.T.W. - *Science for Tomorrow's World* (Collier, Macmillan)

Code for Media:

	Films
	Film Loop
	Filmstrip
	Records
	Tapes
[]	Slide or Transparencies

NOTE: Top of pages are marked according to grade, conceptual scheme and concept number.

Examples of Possible
Activities and Investigations Instructional Materials

		C.I.S.	S.M.A.	S.T.W.	MEDIA
<u>Concept # 1</u> Energy must be used to set an object in motion or to alter its motion. <u>Subconcept # 1</u> Electric energy may be used to set an object in motion. <u>Process Skills Emphasized</u> Observing, communicating, predicting Observing, inferring	1. Show an electric clock to the children. How can we make it run? Plug in the cord. Do you see anything? 2. Get a damaged record. Place it on a turn table. Disconnect the cord. Why has the record stopped moving?	T-4			B <i>Introduction to Energy</i> Y. L. P. B <i>Energy and Matter</i> EBF B <i>Making Things Move</i> EBF

1A

C - 1

Examples of Possible
Activities and Investigations

Instructional Materials

Subconcept # 2		C.I.S.	S.M.A.	S.T.W.
Chemical energy may be used to set an object in motion. <u>Process Skills Emphasized</u> Observing, inferring Classifying	1. Arrange a demonstration using an almost empty gasoline operated mower. Why won't it go now? Add some gasoline. What made it go again? 2. Children gather pictures of machines that get energy from gasoline alone with pictures of other machines that get their energy from electricity, man, etc. Have them classify.	T5		T26-27
<u>Subconcept # 3</u> The energy in moving air may be used to set an object in motion. <u>Process Skills Emphasized</u> Observing, inferring Observing, experimenting	1. Place a balloon on the table. How can you make the balloon move without touching it? Offer the children a cardboard fan. Have the children trace the energy changes. (e.g., energy of pupil blows air - energy of moving air hits balloon - balloon moves) 2. Tie a string an inch from the edge of a piece of paper. Have the children walk with it. Why does it go up in the air? Have the children trace the energy changes (energy of pupil required to pull paper).			T20-25

MEDIA:

Example of Possible
Activities and Investigations Instructional Materials

		C.I.S.	S.M.A.	S.T.W.	MEDIA
<u>Subconcept # 4</u> The energy in moving water may be used to set an object in motion. <u>Process Skills Emphasized</u> Observing, predicting, experimenting Observing, inferring	1. Place a plastic toy in a pan of water. Can you think of two ways of making the toy move without touching it? 2. Make a pinwheel of aluminum foil. Hold the pinwheel in a gentle stream of water. What makes it move? Have the children trace the energy changes (energy of moving water to turning pinwheel).	T-7			
<u>Concept # 2</u> Energy is used to do work. <u>Subconcept # 1</u> A machine is used to help push or pull an object. <u>Process Skills Emphasized</u> Observing, interpreting data, defining terms, inferring, quantifying	1. Initiate a discussion by asking children to recall some objects with which they have been playing or working. Direct their attention to methods used to move objects above the floor and emphasize the terms <u>push</u> and <u>pull</u> . Help				B <i>The Story of Machines</i> C.F. B <i>Laidlaw</i> T-P 105-117

Examples of Possible
Activities and Investigations Instructional Materials

		C.I.S.	S.M.A.	S.T.W.	MEDIA
	them to understand that such activities as kicking a ball or swinging a bat are ways of pushing an object. Emphasize source and point of application of the push or pull. Develop the idea that something must move in order for work to be done.				
<u>Process Skills</u> <u>Emphasized</u> Inferring, quantifying Classifying, communicating	2. Place articles into a toy truck. Another child pulls the truck. What part of the truck makes the work easier? 3. Have children gather and classify pictures or collections of toys according to whether each machine helps to <u>push</u> or <u>pull</u>.	T-8,9		T-44, 49	✂ <i>Making Things Move</i> E.B.F.
<u>Subconcept # 2</u> Energy is used to overcome friction.					
<u>Process Skills</u> <u>Emphasized</u> Quantifying, interpreting data, defining terms (friction) Quantifying, interpreting data	1. Attach an elastic band to a toy truck. Which is the easier way to move the truck, on its side or on its wheels? Record length of elastic band in each case. (e.g. number of sticks long) 2. Place a flat piece of board on top of some steel balls that have been placed about 6" apart on the floor.	T-10, 11	T-48, 53		

Examples of Possible
Activities and Investigations

Instructional Materials

		C.I.S.	S.M.A.	S.T.W.
<u>Subconcept # 3</u> More energy is used to overcome sliding friction than to overcome rolling friction. <u>Process Skills Emphasized</u> Observing, inferring Quantifying, communicating, interpreting data	If a boy sits on the board, can he be moved easily? 1. Children bring a box and a wagon. Have them take turns at pulling each other, first using the rope tied to the box, then the wagon. 2. Attach a block of wood for pulling. Pull it along a smooth floor and then over some sandpaper. Place steel balls under the block of wood to serve as rollers. Pull across the sandpaper again. Measure with spring balance and record. Why is it easier to move now?	T-12, 13		
<u>Concept # 3</u> Energy must be used to do work. <u>Subconcept # 1</u> The greater the amount of work done, the greater the amount of energy expended.				

MEDIA:

Examples of Possible
Activities and Investigations Instructional Materials

		C.I.S.	S.M.A.	S.T.W.
<u>Process Skills Emphasized</u> Observing, predicting Observing, classifying	1. One child touches his toes rapidly while another does the same thing slowly. Record the scores for 10 seconds play for each person. Was the time the same for all? Does it take more energy for a child to move rapidly than to move slowly? 2. Children seek illustrations of things that use much energy to go fast but not so much energy when going slowly. i.e. horse galloping or walking, boy running or walking, etc.	T-13		
<u>Subconcept # 2</u> More work can be done in less time when machines are used. <u>Process Skills Emphasized</u> Observing, inferring, communicating Observing, predicting	1. On separate slips of paper ask several children to write a message for 20 others. Note the time this takes. Have one child print this same message on a stencil. Take the class to the duplicating machine. Discuss the time taken to produce copies. 2. One child tries to whip cream with a fork. Another with a rotary egg beater.	T-16		

MEDIA:

Examples of Possible
Activities and Investigations

Instructional Materials

		C.I.S.	S.M.A.	S.T.W.
<u>Subconcept #3</u> The rate at which energy is supplied determines the rate at which work is done. <u>Process Skills Emphasized</u> Inferring Observing, communicating, experimenting	1. Select a child to carry two books across the room. Repeat with other children each carrying the same number of books. Why do two children do more work than one? 2. Children bring a construction set of dinky toys. Have them demonstrate how the machines operate and tell about the work they do.	T-14, 15		
<u>Subconcept #4</u> The rate at which energy is used determines how fast the work can be done. <u>Process Skills Emphasized</u> Observing, communicating Inferring, predicting, quantifying	1. Fasten a pulley. Tie a weight to one end of a rope and thread the other end through the pulley. If you pull quickly on the loose end of the rope, does the weight move faster or slower? 2. Repeat the experience of using a pulley to lift a weight. Remove the rope from the pulley and let the children take turns raising the basket by pulling the twine over the back of a chair. Which is the easier way to lift the weight? Children could use a spring balance and record their observation and compare.	T-17 T58-60		

MEDIA:

Examples of Possible Activities and Investigations	Instructional Materials
1. Graphical Representation: Plot the data from the table on a graph with "Time (minutes)" on the x-axis and "Distance (meters)" on the y-axis. The data points are (0,0), (10,10), (20,20), (30,30), (40,40), (50,50), (60,60), (70,70), (80,80), (90,90), and (100,100). Connect the points to form a straight line. 2. Rate Calculation: Calculate the rate of motion in meters per second (m/s) for different intervals. For example, from 0 to 10 seconds, the distance increases by 10 meters, so the rate is $10 \text{ m} / 10 \text{ s} = 1 \text{ m/s}$. Repeat for other intervals to confirm the constant rate. 3. Distance-Time Relationship: Derive the equation for the distance traveled as a function of time. Since the rate is constant at 1 m/s, the equation is $d = t$, where d is distance in meters and t is time in seconds.	1. Graph Paper: A grid of graph paper for plotting the distance-time data. 2. Calculator: A calculator to perform the rate calculations and derive the equation. 3. Measurement Tools: A stopwatch and a meter stick to collect the data points.

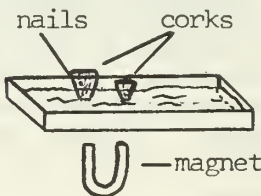
		C.I.S.	S.M.A.	S.T.W.	MEDIA
<u>Concept # 4</u> Energy must be used to do work.					Gravity McGraw Hill
<u>Subconcept # 1</u> Energy must be used to do work against the pull of gravity.					Gravity Y.A.F.
<u>Process Skills</u> <u>Emphasized</u> Observing, inferring	1. Children take turns tossing a ball in the air. What does the ball do after it is tossed? What makes it go up? What makes it come back down?	T-20-22			
Observing, predicting	2. Have a child pour colored water from one tumbler to another. Why does the water go down into the tumbler rather than up to the ceiling? Can you think of two ways to get this water from the tumbler to your mouth?				
<u>Subconcept # 2</u> A force can be used to counteract another force.					
<u>Process Skills</u> <u>Emphasized</u> Observing, predicting	1. Children fasten one end of rubber band to surface. Stretch band with other hand. How many forces are acting on the band? Measure force with scale. Now take				

Examples of Possible
Activities and Investigations Instructional Materials

		C.I.S.	S.M.A.	S.T.W.	MEDIA
Observing, predicting	the band and stretch from both ends and measure with two scales. Do the scales read the same? Is work being done? 2. Blow up an oblong balloon. Hold it neck down. What will happen when I let it go? When the children observe that the balloon goes off, up and sideways before it falls, repeat the investigation with other balloons. What makes the balloon take off? What pulls it down? 3. Have some children individually sit on a board that has been placed on top of some steel balls and then throw a ball. Have them predict what they think will happen. What happened?	T25			
<u>Concept # 5</u> Force is used to counteract force <u>Subconcept # 1</u> Magnetic forces can be used to overcome the force of gravity. <u>Process Skills</u> <u>Emphasized</u> Observing, predicting	1. Give children a magnet and three metal washers. Ask the children if they can think of ways in which the washers might be picked up quickly. Children use the magnet to pick up the washers.			T-50, 51	B <i>Magnets</i> McGraw Hill B <i>Magnets and How We Use Them</i> Jam Handy B <i>Magnets Can Attract Through Objects</i> Jam Handy B <i>Exploring Science</i> Thurber T-54 - 58

Examples of Possible
Activities and Investigations

Instructional Materials

		C.I.S.	S.M.A.	S.T.W.
Observing, inferring, experimenting, classifying	2. Give children a collection of 3 to 4 nails, one of which is aluminum. Have the children use their magnets to pick up the nails. (a discrepant event occurs when aluminum nail cannot be picked up) Supply the children with other objects e.g. lead weights, bobby pins, plastic vials etc. Have children classify objects. Will a magnet attract another magnet? Have the pupils find out. Do the magnets push or pull?			
<u>Subconcept # 2</u>				
Magnets do not have to touch objects to exert force on them.				
<u>Process Skills Emphasized</u>				
Observation	1. Put a small washer inside a tumbler. Move a magnet beneath the glass. Does the washer move? Does magnet work through glass? (Emphasize pull)			T-52-53
Observation, interpreting data	2. Unobserved by the pupils, place some nails inside one cork. Place the cork with the nails in it and another cork in a pan of water. Without the children seeing, move the magnet around under the corks. Have the children tell you why they think the one cork moved and the other didn't.			
<u>Subconcept # 3</u>				
The greater the force the greater is the amount of work done.	 nails corks U — magnet			

Examples of Possible
Activities and Investigations

Instructional Materials

<u>Process Skills Emphasized</u>		C.I.S.	S.M.A.	S.T.W.
Observing, inferring, communicating, quantifying	1. By using a "U" magnet see how many washers (children may tally) can be picked up when it is used as follows: (1) (2) (3)  Try other magnets.	T-27		T-56

Teachers Notes:

GRADE I

CONCEPTUAL SCHEME B

When matter undergoes a chemical change, the total amount of matter remains unchanged.

SUGGESTED MATERIALS AND EQUIPMENT

rocks, plastic bags, bowl, food coloring, ice cubes, sand, fork, sugar cubes, thermometer, modelling clay or "silly putty", plastic dish, butter, shortening, wax, magnifying glasses, sponge or cloth, two pint jars, 26"x8" pieces of cloth, cologne or alcohol, bottle of ginger ale, kettle, cookie sheet, glass, spoons.

RECOMMENDED REFERENCES

Code: C.I.S. - *Concepts in Science* (Longmans)
S.M.A. - *Science, A Modern Approach* (Holt, Rinehart)
S.T.W. - *Science for Tomorrow's World* (Collier, Macmillan)

Code for Media:

- ▶◀ Films
- ▶◀? Film Loop
- ▢ Filmstrip
- ⊙ Records
- _● Tapes
- [] Slide or Transparencies

NOTE: Top of pages are marked according to grade, conceptual scheme and concept number.

Examples of Possible
Activities and Investigations Instructional Materials

		C.I.S.	S.M.A.	S.T.W.	MEDIA
<u>Concept #1</u> Matter exists in various forms and states. <u>Subconcept #1</u> Matter may exist as solid, liquid or gas. <u>Process Skills Emphasized</u> Observing Observing, inferring	1. Place some rocks and some water in plastic bags. Sweep an open plastic bag through the air and then tie. Let the children feel as well as look at the bags. Discuss shape. Do several investigations to establish properties of air. 2. Children empty bags of rocks. What happens to its shape? What happens when the water is emptied into the bowl? How can you tell that the air has gone out of the third bag?	T-30			B Solids Liquids Gases and Molecules Y.L.P.
<u>Subconcept #2</u> Common forms of matter may exist as either a solid, liquid, or a gas. <u>Process Skills Emphasized</u> Observing, inferring	1. Place rocks in one plastic bag, pour colored water in another and fill a third bag with air. Children empty the three bags into a large jar with water in it. Do the rocks keep their	T-31		T7	

Examples of Possible
Activities and Investigations Instructional Materials

		C.I.S.	S.M.A.	S.T.W.
Classifying	shape when they are in the water? Does the water keep its shape? Is the air going out of the bag? How could you find out? 2. Children collect objects and pictures which are solids, liquids and gases. Use a modelling clay or "silly putty" to show that some substances are difficult to classify. Sand might be used here. How is sand different from a liquid? You can feel the particles of sand which is not possible with the liquid.	T-30	T40-4	
<u>Subconcept #3</u> The state of matter can change. <u>Process Skills Emphasized</u> Observing, predicting and communicating	1. Stack 3 to 4 sugar cubes on a plastic dish. Ask the children to predict what would happen if a small amount of water were poured around the cubes. Discuss the changes that occur. Take a drop of sugar water solution. Let water evaporate. Taste solution. Have children observe crystals with magnifying glasses. Emphasize change.	T-32	T32,34 T37-38	

MEDIA:

Examples of Possible
Activities and Investigations Instructional Materials

		C.I.S.	S.M.A.	S.T.W.
Observing, communicating	2. Children collect and prepare a display of items that change from a solid to a liquid. i.e. butter, shortening, wax. These substances will melt in warm sunshine.			
<u>Subconcept #4</u>				
Heat energy can be used to change a solid to a liquid.				
<u>Process Skills Emphasized</u>	1. Present two identical containers each with a few pieces of ice. How can the ice be made to melt faster? Place one pan in direct sunlight on the windowsill and one in the shade. Keep a record of the time required for ice to melt in each pan.	T-33		
Observing, predicting, inferring, quantifying				
Observing, communicating, predicting, inferring	2. Children explore with thermometers in ice water, cold, and warm water. What do you see?			
<u>Subconcept #5</u>				
Heat energy is given off when a liquid changes to a solid.				
<u>Process Skills Emphasized</u>	1. Record the temperature of warm water. Place the warm water outdoors or in a refrigerator. Record the temperature when the water has turned to ice. Help the children to see that getting cold means losing heat.	T-34		
Observing, inferring				

MEDIA:

Examples of Possible
Activities and Investigations Instructional Materials

		C.I.S.	S.M.A.	S.T.W.
<u>Subconcept # 6</u>				
Matter changes in state as the temperature changes.				
<u>Process Skills Emphasized</u>	1. Record the temperature of snow. Observe crystalline shape of snowflakes with a magnifying glass. Make a little snowman. Put it in a pan and bring it indoors. Leave it to the end of the day. Record the temperature. Discuss.	T-35		T18-19
Observing, communicating, inferring				
Observing, predicting, communicating	2. Keep a daily record of outdoor temperature. Take readings in the same place and at the same time each day.			
<u>Subconcept #7</u>				
When liquids evaporate gases are formed.				
<u>Process Skills Emphasized</u>	1. A child makes a strip on the chalkboard with a wet sponge. What happens to the water? Make two other wet spots on the board. Have a child fan one spot to make it dry faster.	T-36		T8-11
Observing, inferring, predicting, communicating				
Observing, inferring, quantifying	2. Children place water in a jar and mark level. With a glass-marking pencil record the water level each day. What do you see happening? Can you tell why?			

MEDIA:

Examples of Possible
Activities and Investigations Instructional Materials

		C.I.S.	S.M.A.	S.T.W.
<u>Subconcept #8</u>				
Heat energy is needed for evaporation to occur.				
<u>Process Skills Emphasized</u>	1. Put equal amounts of water into two equal sized jars. Mark the water level of each with masking tape. Store one jar in a cool place; the other in a warm place. From which jar does the water evaporate faster?	T-37		T-8
Observing, quantifying				
Observing, predicting	2. Soak two 6" x 8" pieces of cloth in water. Place one in the coolest place in the room and the other on a register. Which piece of cloth will dry first?			
<u>Concept #2</u>				
Matter exists in various forms and states.				
<u>Process Skills Emphasized</u>	1. Put a dab of cologne or alcohol on the back of each child's hand. Let the children observe (see, feel, smell) what happens as the liquid evaporates.	T-38		
Observing, inferring				
Observing, inferring, predicting	2. Bring in a bottle of gin- ger ale. Open it and ask the children to show you three different states.			

MEDIA:

Examples of Possible
Activities and Investigations Instructional Materials

		C.I.S.	S.M.A.	S.T.W.	MEDIA
<u>Concept #3</u> Evaporation and condensation are changes in the state of matter. <u>Subconcept #1</u> When warm air touches a cold object, water comes out of the air. <u>Process Skills Emphasized</u> Observing, inferring Observing, inferring	1. Boil a kettle. Place a cookie sheet in the vapor. What do you see on it? Is the water in tiny droplets or in large drops? Where are the drops of water coming from? 2. Fill a tumbler with ice cubes (cold water). Place it in a warm room. What do you see on the outside of the tumbler? Where did this water on the outside come from?	T-41		T12-15	✕ <i>Finding Out About Clouds S.V.E.</i>
<u>Subconcept #2</u> Clouds and precipitation result from the cycle of evaporation and condensation. <u>Process Skills Emphasized</u> Observing, predicting, inferring	1. Boil a kettle of water. Place a cold pan in the cloud of water vapor. Leave the drops of water for a few hours. Where did the water go?	T-41		T16-17	<i>Search and Discover</i> T-133 - 136

Examples of Possible
Activities and Investigations Instructional Materials

		C.I.S.	S.M.A.	S.T.W.
Observing, predicting, inferring	2. Use a wide-mouthed bottle. Cover the bottom with some soil. Moisten the soil with about 1/2 cup of water. Cover the top with a plastic bag. Set the bottle on a window sill and observe. What did you see form on the plastic top and on the sides of the jar. Where did this water come from? What happens to these drops of water?			
<u>Subconcept #3</u> The cycle of evaporation and condensation is a result of heat exchange.				
<u>Process Skills Emphasized</u> Observing, inferring	1. Chill some spoons. Children exhale gently on the spoons. What do you see on the spoons? What is the cloud made of?	T-44		T16-17
Quantifying, inferring, controlling variables	2. Children measure one cup of water into two identical glasses. Mark the water level with adhesive tape. Ask them to find a dark place in the room for one jar and a place where it will get heat from the sun for the other.			
<u>Subconcept #4</u> The weather cycle is related to the water cycle.				

MEDIA:

Examples of Possible
Activities and Investigations Instructional Materials

		C.I.S.	S.M.A.	S.T.W.
<u>Process Skills Emphasized</u> Observing, predicting, inferring	1. Use the opaque projector to discuss the picture on page 47 of C.I.S. Are the farmhouse and the barn getting wet? Why not?	T-46-47		

MEDIA:

GRADE I

CONCEPTUAL SCHEME C

Organisms are interdependent with each other and with their environment.

SUGGESTED MATERIALS AND EQUIPMENT

soil, cups, bean seeds, dropper, aluminum pan, cotton seeds, mealworms, plastic, sand, stones, aquarium or fish bowl, aquarium plants, magazines, apple, tomato, board.

RECOMMENDED REFERENCES

Code: C.I.S. - *Concepts in Science* (Longmans)
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Examples of Possible
Activities and Investigations Instructional Materials

		C.I.S.	S.M.A.	S.T.W.	MEDIA
<u>Concept #1</u> There is an interchange of matter and energy between living things and their environment. <u>Subconcept #1</u> All living things need food, water, and air to survive. <u>Process Skills Emphasized</u> Formulating hypotheses, quantifying, predicting, interpreting data Observing	1. Children fill two cups with sifted soil. Plant 3 seeds in each cup. Give cup A 15 drops of water daily. Give cup B 1 drop daily. 2. Make two observation sprouting gardens by using two aluminum pans. Put a thin layer of cotton on the bottom of the pans. Wet the cotton. Cover with clear plastic. Place the boxes in a warm but shady place. When seeds sprout sift some good soil over one box of sprouts. Keep the soil damp and leave the gardens in the shade until the plants come up. Are there any differences in the two gardens?	T-96-99		T-102, 103	➤ <i>What Plants Need For Growth</i> E.B.F. ➤ <i>Learning About Seeds</i> E.B.F.
<u>Subconcept #2</u> Plants and animals interact through a food relationship.					

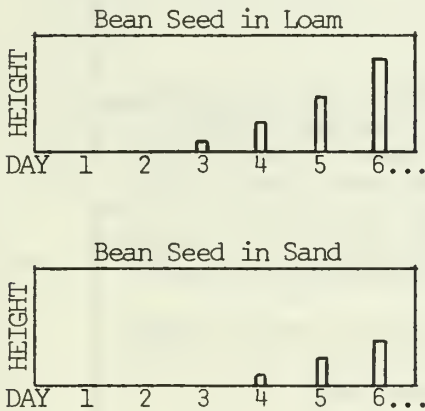
Examples of Possible
Activities and Investigations Instructional Materials

		C.I.S.	S.M.A.	S.T.W.	MEDIA
<u>Process Skills</u> <u>Emphasized</u>	1. Set up aquarium in class- room. What do you see in the aquarium?	T-106 107		T-102 103	
Observing, inferring					
Observing, inferring	2. Using wide mouth bottles and slough water along with a few plants obtained from the slough have the pupils establish their own aqua- rium. What causes the water to eventually turn green? What do the little animals eat? Observe the animals with a lens. Would tap water turn green in time?				
<u>Concept #2</u>					
Organisms reproduce their own kind.					B Farm Animals S.V.E.
<u>Subconcept #1</u>					B The Turtles Curriculum
The size and structure of an organism is determined by heredity and environment.					B How Animals Live In Fresh Water H. 16
<u>Process Skills</u> <u>Emphasized</u>					
Observing, inferring, classifying	1. Children match picture puzzles of animals and their babies.				B How Animals Live In Grasslands H. 17
Observing, classifying, inferring, predicting	2. Children bring pets to school. Library research to find out what these animals' parents are like.	T-82,83 T-110- 112		T-Unit VI	B Animal Babies S.V.E. B Finding Out How

Examples of Possible
Activities and Investigations Instructional Materials

		C.I.S.	S.M.A.	S.T.W.	MEDIA Animals Live S.V.E.
<u>Subconcept #2</u> Anatomical structure in animals relate to function. <u>Process Skills</u> <u>Emphasized</u> Observing, inferring, classifying, communi- cating Observing, inferring, classifying, communi- cating, formulating models	1. Have children observe meal- worms, spiders, beetles, goldfish and pictures of other animals to see how their structure suits them to their environment e.g. gills for breathing, shape of mouth for eating, shape of body for moving... 2. Children prepare charts showing animals that climb, animals that fly, animals that have fins, animals that have feet which help them to climb. Consider goldfish in aquarium. What function do gills serve, mouth , tail, various fins, eyes, etc.?	T-112 113			
<u>Concept #3</u> There is an interchange of matter and energy between living things and their environment. <u>Subconcept #1</u> Hereditary factors develop within a given environment but the characteristics of the species are not generally altered.					B Paul's Puppy Curr. B Billy Beaver Curr. B Terry's Turtle Curr. B Living Things Are Everywhere F.O.M.

Examples of Possible
Activities and Investigations Instructional Materials

		C.I.S.	S.M.A.	S.T.W.	MEDIA
<u>Process Skills</u> <u>Emphasized</u> Observing, inferring, quantifying Observing, quantifying, communicating Observing, inferring, quantifying <u>Subconcept #2</u> The size and structure of an organism are limited by heredity regardless of the environment.	1. Present an apple and a tomato to the children for identification. What is found inside each fruit? What could grow from apple seeds? 2. Children plant a bean seed in loam and one in sand both at the same depth. As the first plant breaks through the surface start a graph using strips of paper.  3. Study mealworms. Compare mealworm for size and shape. Do they all have the same number of legs, segments to body.				B <i>How</i> <i>Animals</i> <i>Prepare for</i> <i>Winter</i> NFB B <i>How</i> <i>Animals Live</i> <i>in The</i> <i>Arctic</i> Curr. B <i>Animals</i> <i>of the Pond</i> <i>Curr.</i> B <i>Hiberna-</i> <i>tion</i> Curr. B <i>Reptiles</i> <i>of the</i> <i>Desert</i> E.B. B <i>Insect</i> <i>Homes</i> Jam <i>Handy</i> B <i>The</i> <i>Desert</i> Curr. B <i>The</i> <i>Turtles</i> <i>Curr.</i> B <i>Birds of</i> <i>Our Commu-</i> <i>nity</i> S.V.E.

Examples of Possible
Activities and Investigations Instructional Materials

		C.I.S.	S.M.A.	S.T.W.	MEDIA
<u>Process Skills</u> <u>Emphasized</u> Observing, classifying, inferring	1. Take the children on a field trip to study animal homes. (Many homes of insects can be found right on the school yard.) Why do ants build homes like they do? Why do ants not build their homes in ponds like the beaver? Why do bees build their homes in trees or in protected places? Why is a burrow a good home for a gopher?			T-114-118	
Observing, classifying, inferring, communica- ting	2. Children prepare a class booklet of animals and their homes.				

CONCEPTUAL SCHEME A

When energy changes from one form to another, the total amount of energy remains unchanged.

SUGGESTED MATERIALS AND EQUIPMENT

wheat seeds, flower pots, wide-mouth bottles, lens, small pieces of wood, leaves, plastic dishes, bean seeds, lamp, coal, sandstone, oil, string, test tubes, washers, yardsticks, alarm clocks, tuning forks, styrofoam balls, aquarium, rulers, rubber bands, balloons, droppers, candles, copper wire, lamps, flashlight batteries, mirrors, prisms.

RECOMMENDED REFERENCES

Code: C.I.S. - *Concepts in Science* (Longmans)
S.M.A. - *Science, A Modern Approach* (Holt, Rinehart)
S.T.W. - *Science for Tomorrow's World* (Collier, Macmillan)

Code for Media:

-  Films
-  Film Loop
-  Filmstrip
-  Records
-  Tapes
-  Slide or Transparencies

NOTE: Top of pages are marked according to grade, conceptual scheme and concept number.

Examples of Possible
Activities and Investigations Instructional Materials

		C.I.S.	S.M.A.	S.T.W.	MEDIA
<u>Concept #1</u>					
The sun is our prime source of energy.					
<u>Subconcept #1</u>					☞ <i>Sun's Energy Academy</i>
Green plants use and store energy from the sun.					☞ <i>Big Sun And Our Earth Coronet</i>
<u>Process Skills Emphasized</u>					
Observing, communicating, interpreting data	1. Children plant a kernel of wheat in each of two identical containers. As soon as the shoots appear, cover one container with a brown paper bag. Each day compare the two plants. Keep a graph of plants' growth. Place the yellow wheat in the sun for a few days. What happened? What would happen to plants if there were sunlight 24 hours a day?	T26-27		T83-89	☞ <i>How Sunshine Helps Us Coronet</i> ☞ <i>What Plants Need For Growth E.B.F.</i> ☞ <i>Tree Is A Living Thing N.B.F.</i> ☞ <i>Seasonal Changes In Trees Coronet</i>
Observing, inferring	2. Children place slough water in two wide-mouth jars. Place one in sunlight, keep the other in the shade. What differences are noticed after a period of a week or two? (Green algae appears in jar in sunlight.) Observe green plants with lens.				
<u>Concept #2</u>					
Chemical energy can be changed to light energy and heat energy.					

Examples of Possible
Activities and Investigations Instructional Materials

		C.I.S.	S.M.A.	S.T.W.	MEDIA
<u>Subconcept #1</u> When a fuel burns, energy is released. <u>Process Skills</u> <u>Emphasized</u> Observing, inferring, formulating models, defining Inferring, formulating models, (energy change), defining terms	1. Teacher burns a small piece of wood - the <u>fuel</u> . What do you see happening? (Heat and light given off.) Emphasize that energy came from sun - wood (plant) Where it was stored - burned (light and heat)	T89- 93 T26-27		T90-93	
	2. Have children burn dry leaves and stems. What is the black substance? (Carbon) Where did the energy (heat and light) come from for the fire? Trace the energy change: sun's energy - energy stored in plant - light and heat energy from burning.	T28 T29		T123- 124 T130	
<u>Concept #3</u> Energy can be transferred from one place to another. <u>Subconcept #1</u> Energy can be captured from the sun and stored in green plants. <u>Process Skills</u> <u>Emphasized</u> Observing, interpreting data, quantifying	1. Place a piece of paper towel in the bottom of a plastic dish. Add water until the paper is just covered. Place four bean seeds in the dish. Cover	T30- 31			

Examples of Possible
Activities and Investigations Instructional Materials

	them with a piece of damp paper towel and leave seeds to germinate. When they start to germinate cut away half of the cotyledon in two seeds. Be careful not to damage the embryo. Plant the seeds with full cotyledons in one pot. And the other seeds with half cotyledons in another pot. Water carefully. How long did the plants in each pot grow? Why did they stop growing in one pot before the other? (Emphasize that in one pot the seeds had no more stored food.)	C.I.S.	S.M.A.	S.T.W.	MEDIA
<u>Subconcept #2</u> When a fuel burns, energy is released. <u>Process Skills</u> <u>Emphasized</u> Observing Inferring, developing model Classifying	1. Have children discover there is carbon in oil when lampblack collects a piece of glass. Also, there is carbon in candle. This carbon can be collected on a plate. 2. Burn a piece of coal. What energy was produced? Where did the coal come from? Where did the plants get their energy? 3. Begin a collection of carbon and things that contain carbon.	T32-33			

Examples of Possible Activities and Investigations Instructional Materials

		C.I.S.	S.M.A.	S.T.W.	MEDIA
<u>Subconcept #3</u>					
Oil is a fuel which contains energy that was captured from the sun and stored by green plants.					
<u>Process Skills Emphasized</u>	1. Put oil on sandstone. What happens? Put oil on glass. Emphasize that the oil in the earth is in porous rock. Fill a small plastic vial with marbles. Is the jar really full? Then have the pupils pour water in to the jar to show that the jar was not full. Pour out half of the water. Pour in oil; place cap on vial and turn upside down. What happened? Why does the oil stay on the top?	T34- 35			
Observing, inferring, formulating models					
<u>Subconcept #4</u>					
Gas is a fuel which contains energy that was captured from the sun and stored by green plants.					
<u>Process Skills Emphasized</u>	1. Make a model of an oil well using marbles, oil, water, and plastic vials. Trace the transfer of energy; sun's energy - Plants - Animals - Fuels. Why is the air (the gas) on top, the oil in the middle, and the water on the bottom? What is the difference between gas and gasoline?	T36 T37			
Inferring, formulating models					

Examples of Possible
Activities and Investigations Instructional Materials

		C.I.S.	S.M.A.	S.T.W.	MEDIA
<u>Concept #4</u> Energy can be transferred through the molecules of solids, liquids and gases. <u>Subconcept #1</u> Sounds are made in different ways. <u>Process Skills Emphasized</u> Observing, experimenting	1. Children are given a number of objects such as string, test tube, washer, etc. Have them find ways that sounds may be produced; for example, blowing over test tube's open end, tapping washer, plucking string, dropping water into a pail with a dropper, etc.	T40-45 T54-55	T64 T69-71 T94-95		➤ <i>Sound And How It Travels</i> E.B.F.
<u>Concept #5</u> Sound is a transfer of energy through the molecules of solids, liquids and gases. <u>Subconcept #1</u> Sound is a result of vibration (energy motion). <u>Process Skills Emphasized</u> Observing (seeing, hearing and touching), formulating models	1. Children find that various states of matter can carry sound: a) Place one end of yardstick on your head and the other end on ringing alarm clock. Can you feel the <u>vibration</u> ?		P100-102 104 109		

Examples of Possible
Activities and Investigations Instructional Materials

		C.I.S.	S.M.A.	S.T.W.	MEDIA
	b) Rap a tuning fork on something solid, then place fork on side of head. What do you observe? Place a vibrating tuning fork into a glass of water. What happened? What happens to a styrofoam ball when touched with the vibrating tuning fork? Why? c) Tap on the side of an aquarium. Do the fish move? Why? d) Why is it we can hear sounds through air? Bring out the idea that a solid, liquid or gas must be vibrating in order for sound to be produced and that sound is a form of energy.		T68- P101- 102		
<u>Concept #6</u> Sounds vary in pitch. They may be high or low. <u>Subconcept #1</u> The greater the frequency of vibration, the higher the pitch of sound.					

Examples of Possible
Activities and Investigations Instructional Materials

		C.I.S.	S.M.A.	S.T.W.	MEDIA
<u>Process Skills</u> <u>Emphasized</u> Observing, interpreting data	1. Let about 9" of a 12" wooden ruler hang over the edge of desk. Hold the short end firmly and snap the end that extends over. What kind of sound do you hear? Can you see the ruler extend beyond the desk? Snap the end again. What do you observe? Describe the sound you hear. How is it different from the first sound?	T46	T64-67 T69	T4	B <i>Finding Out About Sound S.V.E.</i>
Observing, interpreting data, defining terms	2. Children pluck thick, thin, short and long rubber bands, etc. and compare <u>pitch</u> . When do we get high sounds? When do we get low sounds?				
<u>Concept #7</u> Sounds travel through solids, liquids or gases.					
<u>Subconcept #1</u> Sound travels in a wave pattern through molecules of solids, liquids or gases.					
<u>Process Skills</u> <u>Emphasized</u> Observing, formulating models	1. Drop a washer into a dish filled with water. What do you observe? Emphasize that <u>we think</u> this is the way sound waves travel.	T47-49	T71		

2A

C - 8

C - 9

Examples of Possible

Activities and Investigations Instructional Materials

		C.I.S.	S.M.A.	S.T.W.	MEDIA
	2. Place a vibrating tuning fork on the surface of water. What do you observe? 3. Pupils draw picture (model) of how we think sound travels. 4. Do sounds travel fastest in solids, liquids or gases? How could we find out?				
<u>Concept #8</u> Sound travels through solids, liquids and gases. <u>Subconcept #1</u> Speech is the result of sound patterns made when the vocal cords vibrate molecules of air. <u>Process Skills</u> <u>Emphasized</u> Observing, interpreting data, controlling variables, formulating models					B <i>Sounds We Hear</i> S.V.E.
	1. Blow up a balloon. Hold each side of the neck of the balloon with the thumb and forefinger of each of your hands. As the air goes out of the balloon, pull on each side of the neck of the balloon. What happens as you stretch the neck of the balloon?	T50			
<u>Concept #9</u> Sound waves travel through molecules of solids, liquids or gases. <u>Subconcept #1</u> Sound waves may be reflected.					

Examples of Possible
Activities and Investigations Instructional Materials

		C.I.S.	S.M.A.	S.T.W.	MEDIA
<u>Process Skills</u> <u>Emphasized</u> Observing, inferring, predicting	1. Pupils drop a small washer into a plastic dish of water. Note the size of the waves. Drop a large washer into the same container. Are the waves the same size? What happens to the waves when they strike the side of the container? 2. Visit the auditorium or gymnasium to experiment with the formation of echoes. (must be 55 ft long)	T51	T69-70 P105		
<u>Concept #10</u> Sound is a transfer of energy in a wave pattern through molecules of solids, liquids or gases.					
<u>Subconcept #1</u> Hearing is the result of a transfer of energy through sound vibrations.					
<u>Process Skills</u> <u>Emphasized</u> Observing, inferring	1. See investigations and discussions in textbooks.	T52-53	T71-72 P110-113		
<u>Subconcept #2</u> Sound does not travel through a vacuum.		T55	P106-109		

Examples of Possible
Activities and Investigations Instructional Materials

		C.I.S.	S.M.A.	S.T.W.	MEDIA
<u>Process Skills</u> <u>Emphasized</u> Observing, inferring Formulating hypothesis	1. If a bell jar and pump are available, get an alarm clock ringing and then exhaust the air. Why can't we hear the alarm ringing? 2. Initiate discussion by asking the children what would happen if the earth had no air? What would we hear?		T71		
<u>Concept #11</u> Light is a form of energy. <u>Subconcept #1</u> Chemical energy can be converted to light energy. <u>Process Skills</u> <u>Emphasized</u> Observing, inferring	1. Children light a candle and observe. What keeps the candle burning? 2. Light a match. Then light a second one. What do you observe? Emphasize that the energy in the wood is being changed to light energy and heat energy.	T58-59			◀ Electricity: How To Make a Circuit E.B.F.
<u>Subconcept #2</u> Electric energy can be converted to light energy.		T60-61 T62-63 T64-65			

Examples of Possible
Activities and Investigations Instructional Materials

		C.I.S.	S.M.A.	S.T.W.	MEDIA
<u>Concept #12</u> Matter on the sun is converted to energy including light energy. <u>Subconcept #1</u> <u>Process Skills Emphasized</u> Experimenting, inferring Observing, inferring	1. Give the pupils a lamp, copper wire and flashlight battery and ask them to see if they can make the lamp light. Where is the energy coming from to light the lamp? If old batteries are available let the pupils: a) examine the inside of a battery. b) bare a piece of insulated wire and have one end contact the bottom of a flashlight battery and rub the other end across the terminal. What did you see?				B <i>Light And How It Travels</i> J.H.
<u>Concept #13</u> Light is a form of energy. <u>Subconcept #1</u> Light travels in a straight line. <u>Process Skills Emphasized</u> Defining terms, interpreting data	1. Have pupils examine the parts of a flashlight. In a slightly darkened room stand a ruler upon end and shine a flashlight on it. Examine the	T67		T74-75 T75	

Examples of Possible
Activities and Investigations Instructional Materials

		C.I.S.	S.M.A.	S.T.W.	MEDIA
	shadow. Let pupils move the flashlight around to different angles.				
	2. Place a light in front of a straight drinking straw. Observe the straw. What happened? Why? How is light different from sound?				
<u>Subconcept #2</u>					
Light may be transmitted, reflected, bent or absorbed.					
<u>Process Skills Emphasized</u>					
Classifying	1. Pupils collect various kinds of materials. Find out which ones are transparent, which translucent and which opaque.	T68-72	T75		
Classifying	2. Reflect light from a mirror at different angles. Develop model for reflected light by comparing to a bouncing ball. Bounce a ball at various angles.				
Observing, interpreting data	3. Place a pencil in a tumbler of water. What do you see?				
<u>Concept #14</u>					
Light is a form of energy transferred as a wave.					
<u>Subconcept #1</u>					

GRADE II

CONCEPTUAL SCHEME B

When matter undergoes a chemical change, the total amount of matter remains unchanged.

RECOMMENDED REFERENCES

Code: C.I.S. - *Concepts in Science* (Longmans)
S.M.A. - *Science, A Modern Approach* (Holt, Rinehart)
S.T.W. - *Science for Tomorrow's World* (Collier, Macmillan)

Code for Media:

- ◀▶ Films
- ◀▶⌘ Film Loop
- ▢ Filmstrip
- ⊙ Records
- Tapes
- [] Slide or Transparencies

NOTE: Top of pages are marked according to grade, conceptual scheme and concept number.

Examples of Possible
Activities and Investigations Instructional Materials

		C.I.S.	S.M.A.	S.T.W.	MEDIA
<u>Concept #1</u> A molecule is the smallest part of a substance which retains the chemical properties of that substance. <u>Subconcept #1</u> Although molecules are too small to be seen, they may be detected by other methods. <u>Process Skills Emphasized</u> Observing	1. Set the stage for a discussion of molecules by spraying some perfume into the air in the classroom while the children are out of the room. How do we know there is perfume in the air? How do you know when your mother is cooking onions? How do we know when something is cold, smooth, sour, etc.?	T2 T3		T1-29	
<u>Subconcept #2</u> Molecules are too small to be seen, but substances can be detected by sense of smell. <u>Process Skills Emphasized</u> Observing (smelling)	1. Collect foods with distinctive odors and tastes-see references. Blindfold students. Students identify food by smell.	T4			

Examples of Possible
Activities and Investigations Instructional Materials

		C.I.S.	S.M.A.	S.T.W.	MEDIA
<u>Subconcept #3</u> Some substances may be detected by taste. <u>Process Skills Emphasized</u> Observing (tasting)	1. Pupils observe a cube of sugar. Observe a cube of sugar with a magnifying lens. What do you see? Grind up the lump of sugar. Examine a grain under a magnifying lens. Place some sugar in water. Can you see the sugar? How do you know its there? Place a drop of sugar water on a glass slide. Leave for a few minutes. Observe with a magnifying lens. What do you see? Where did the water go? Where did the sugar come from?	T5			
<u>Subconcept #4</u> Molecules of one substance can be diffused with molecules of another. <u>Process Skills Emphasized</u> Observing, quantifying, predicting, inferring, defining terms Observing, quantifying, inferring	1. Investigation with two identical pieces of cloth balanced on the ends of a ruler and suspended from a rod (yardstick). Wet one cloth - observe - discuss. Leave until water evaporates, observe again. 2. Place one end of a blotter in a dish of water. Leave for a few minutes. What do you see? Did the water lower in the dish?	T6			

Examples of Possible
Activities and Investigations Instructional Materials

		C.I.S.	S.M.A.	S.T.W.	MEDIA
<u>Subconcept #5</u> Molecules of one substance may be evenly distributed (dissolved) through molecules of another. <u>Process Skills</u> <u>Emphasized</u> Observing, inferring					
Observing, inferring, formulating models	1. Dissolve sugar in water. Pour water (solution) through cotton. Taste. Place a drop of salt water on a glass slide. Leave for a few minutes. Observe with a magnifying lens. What do you see? Where did the water go? Where did the crystals come from? What do they taste like? 2. Have pupils observe a bottle of pop. Take off cap. What do you see? (bubbles coming out of pop) Where did the bubbles come from?	T-7			
<u>Subconcept #6</u> The motion of molecules determines the state of matter. (solids, liquids, gases) <u>Process Skills</u> <u>Emphasized</u> Classifying	1. Pupils classify the following as solids, or liquids: steel balls, pencil, beans or other seeds, candle, ruler, syrup, milk, bottle of soda pop.	Book 1 T30-41	P57-92 T37-58		<i>What Makes Rain?</i> <i>Finding Out About Heating Solids, Liquids and Gases S.V.E.</i> <i>Finding Out How Things Change S.V.E.</i>

Examples of Possible
Activities and Investigations Instructional Materials

		C.I.S.	S.M.A.	S.T.W.	MEDIA
Observing, inferring	2. Have pupils observe a small bit of paraffin wax. Then place it in a test tube and heat gently. What happened? Why? (Develop idea that additional energy was supplied) Try to develop a theory.				
Observing, interpreting data	3. Have pupils put one end of a drinking straw into a tumbler of water and blow gently through the other end. What is causing the bubbles?	T8			
Hypothesizing	4. Blow up a balloon. Feel the balloon. Why does the balloon stretch? Is there anything inside? Immerse its neck in water and let some air escape. Are the bubbles solid? Liquid? Introduce term <u>gas</u> .				
Observing, classifying, communicating	5. Scoop air into a plastic bag. Feel the bag. How is it different from the solids and liquids?				
Formulating models	6. Develop models for: - solids by fastening styrofoam balls together so that they are rigid. - liquids by placing styrofoam balls in containers of different shapes. Can molecules move around? - gases by placing a few styrofoam balls in a container and shake.				

Examples of Possible
Activities and Investigations Instructional Materials

		C.I.S.	S.M.A.	S.T.W.	MEDIA
<u>Subconcept #7</u> Every substance has its own particular molecular structure, which is determined by the kinds, number, and arrangement of atoms within a molecule.					
<u>Process Skills Emphasized</u> Formulating models	1. View chalk dust and grains of sugar through a magnifying lens. Develop idea that each speck contains millions and millions of molecules. Using styro-foam balls, make model of water molecule. Some pupils may make C molecule.	T9-11			
<u>Subconcept #8</u> Evaporation results when molecules gain enough energy to move apart from one another.					Wind E.B.F.
<u>Process Skills Emphasized</u> Observing, inferring	1. Moisten cotton batting with alcohol. Wipe some alcohol on the back of the hand. What did you observe? Why did the heat go? Where did the alcohol go?	T12-13			Air and What It Does E.B.F.
Formulating models	2. Investigations with wet cloth, water in glass, and mothballs to show that molecules break away and move apart into the air. Construct models to show liquid, then what happens when evaporation occurs.				Air Around Us E.B.F.

Examples of Possible
Activities and Investigations Instructional Materials

		C.I.S.	S.M.A.	S.T.W.	MEDIA
<u>Concept #2</u> Heat energy causes water to expand. <u>Subconcept #1</u> Expansion exerts a force that can be used to do work. <u>Process Skills</u> <u>Emphasized</u> Observing, communicating, inferring, predicting Observing, communicating, inferring, predicting	1. Fit a piece of glass tubing tightly into a rubber stopper. Insert into a test tube full of water so that the water comes part way up the tube. Mark the level of the water with a piece of tape. Heat. What happened? Why? 2. Make a steam generator that will turn a turbine. Is work being done? Trace the energy changes.	T16-17		T119-120	☐ <i>What Is Heat?</i> J.H. ☐ <i>Heat Changes Things</i> J.H. ☐ <i>Where Do We Get Heat</i> J.H. ☐ <i>Heat Makes Things Expand</i> J.H.
<u>Concept #3</u> Heat energy causes air to expand. <u>Subconcept #1</u> Expanding air can exert a force to do work. <u>Process Skills</u> <u>Emphasized</u> Observing, interpreting data	1. See activity page T118, S.T.W. Emphasize that force of expanding air is lifting balloon.	T18-19		T118	☐ <i>Air All Around Us</i>

Examples of Possible
Activities and Investigations Instructional Materials

		C.I.S.	S.M.A.	S.T.W.	MEDIA
Formulating models	2. Place a rubber stopper into the end of a test tube. (to be done by teacher only) Heat gently. What happened? Why? Was work done?				
<u>Subconcept #2</u>					8mm Films: (Single concept) ✂ Air Has Weight FE 1-0
Heat energy can be transferred from one place to another in molecular collisions.					
<u>Process Skills</u> <u>Emphasized</u>	1. Heat one end of a six inch piece of base copper wire while the other end is held between fingers. What happens in a few minutes? Why?	T20-21	T89-90	T121-122	✂ Air Pressure FE 3-0
Interpreting data					✂ Air Occupies Space FE 2-0
Formulating models	2. Using rubber balls between two meter sticks, show how heat is carried along the wire by collisions.				☐ Heat Travel J.H.
<u>Concept #4</u>					
Heat energy causes matter to expand.					
<u>Subconcept #1</u>					
The greater the speed of the molecules, the greater the temperature of the body.					
<u>Process Skills</u> <u>Emphasized</u>	1. Place a drop of ink into two identical tumblers of water. Heat the one tumbler. What do you observe about the solutions at the end of five minutes? Measure their temperatures.				
Observing, quantifying, interpreting data					

Examples of Possible Activities and Investigations Instructional Materials

		C.I.S.	S.M.A.	S.T.W.	MEDIA
<u>Subconcept #2</u>					B <i>Thermometers And How They Work</i>
Expansions result when molecules move faster.					
<u>Process Skills</u>	1. Observe thermometers in sun and in shade. Note changes at end of each minute.	T23	T84-90	T121	B <i>Reading A Thermometer</i>
<u>Emphasized</u>				T117	
Observing, inferring	2. Investigation with nail and washer and with copper wire stretched taut then heated.	T19			

GRADE II

CONCEPTUAL SCHEME C

Living things are interdependent with one another and with their environment.

RECOMMENDED REFERENCES

Code: C.I.S. - *Concepts in Science* (Longmans)
S.M.A. - *Science, A Modern Approach* (Holt, Rinehart)
S.T.W. - *Science for Tomorrow's World* (Collier, Macmillan)

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Examples of Possible
Activities and Investigations Instructional Materials

		C.I.S.	S.M.A.	S.T.W.	MEDIA
<u>Concept #1</u> <u>Subconcept #1</u> Living things are specially adapted to a special environment. <u>Process Skills Emphasized</u> Observing, classifying, communicating, inferring, predicting, formulating hypotheses, controlling variables	1. Have pupils make: a) individual water plant gardens (pupils may get pond plants or purchase aquarium plants) b) individual desert plant gardens c) individual wood plant gardens d) individual land plant gardens 2. Transfer one plant of each kind from its natural environment to a different garden. Observe results.	166-175			➤ <i>Finding Out About Green Plants</i> S.V.E. ➤ <i>How Plants Live</i> E.B.F. ➤ <i>Plant Needs</i> E.B.F. ➤ <i>Where Green Plants Grow</i> J.H. ➤ <i>How Green Plants Grow</i> J.H. ➤ <i>Plant Life Of The Desert</i> E.B.F. ➤ <i>Plant Factories</i> S.V.E.
<u>Subconcept #2</u> Classification of living things is based on characteristics held in common within the group.					➤ <i>A Balanced Aquarium</i> E.B.F.

Examples of Possible
Activities and Investigations Instructional Materials

		C.I.S.	S.M.A.	S.T.W.	MEDIA
<u>Process Skills</u> <u>Emphasized</u>					
Classification	1. As a basis for later work on classification have pupils classify themselves on basis of such things as sex, eye color, age, attached or unattached ear lobes, etc.	176-184		T20-25	
Observing, interpreting data, classifying	2. Put jar of pond or aquarium water in sunlight. Why does it become green and soupy? Observe green algae with lens or microscope. How are algae different from other green plants? Compare algae with bean plant. How are they alike? How are they different?	176-177		T30	
Classifying, interpreting data	3. Start a hay infusion two weeks prior to the time you will need microscopic animals. Compare small life (amoeba, euglena, etc.) found in hay infusion to an animal such as a cat. How does each move? How does each eat? Where does the food for each come from? How are animals different from plants?				
Observing, interpreting data, hypothesizing, experimenting	4. Show pupils a mold you have grown. Is this a plant or animal? It doesn't look like a plant. (confrontation) How do you know it is? Where does it get its energy to			T104	The Parts of a Plant How Seeds Are Scattered

Examples of Possible
Activities and Investigations Instructional Materials

		C.I.S.	S.M.A.	S.T.W.	MEDIA
	make it grow? Children put moistened bread in a bottle with a loose lid. Leave grapes, cut apple, orange, etc., in warm, damp place. A plastic bag is good for this. Let children watch mold grow. Children might investigate. What conditions are best for growing mold? View spore cases and spores under a microscope or double lens.				▶◀ <i>How Trees Grow</i> P.D.P. ▶◀ <i>Plants We Use</i> E.B.F. ▶◀ <i>Green Plants Are Important To Us</i>
Observing, classifying, interpreting data	5. Have pupils examine mushrooms. Children examine spores under microscope. Study pictures and material on bacteria, fungi and yeast.	T178-184		T102-103	
Observing, classifying	6. Examine seed plants with aid of hand lens. Do all seed plants have flowers? (Conifers don't).				

GRADE III

CONCEPTUAL SCHEME A

When energy changes from one form to another, the total amount of energy remains unchanged.

SUGGESTED MATERIALS AND EQUIPMENT

magnifying glasses, metal or pyrex pans, tissue paper, a lamp, globe, adhesive tape, modeling clay, paper flags or toothpicks, 2 outdoor thermometers, 2 yams or green plants (growing in water), potato cuttings - (two eye spots per piece), soil, flower pots, healthy plants, carbon paper, paper clips, empty food cartons, boxes and cans with labels on, aluminum pie pans, plastic sponges, bean seeds, wax paper, electric iron, pinwheels - paper or plastic, radiometer, flashlight, solar radio, cooking thermometers, hot plate, tea, sugar, scissors, large box, black paper, rubber balls, knitting needles (metal), straight pins, aluminum foil

pan of water, toy boat, pail, faucet or hose, cardboard for 8 in. circles, rubber bands, electric fan, tissue paper strips, cardboard fan, candles, safety matches, soft clay, long pencils, test tubes, 10" squares of aluminum foil, half of a 1/4 lb. stick of butter, cotton string 5" long, saucer, knife, electric clock, record player, 6 flashlights to be taken apart, 6 - dry cells - 6 volt, copper bell wire, iron nail or bolt, thumbtacks, screwdriver, electromagnets, electric bells, round cardboard covers, quart milk cartons, damp sand, pebbles, an old telephone, electric wires (insulated)

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RECOMMENDED REFERENCES

Code: C.I.S. - *Concepts in Science* (Longmans)
S.M.A. - *Science, A Modern Approach* (Holt, Rinehart)
S.T.W. - *Science for Tomorrow's World* (Collier, Macmillan)

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Examples of Possible
Activities and Investigations Instructional Materials

		C.I.S.	S.M.A.	S.T.W.	MEDIA
<u>Concept #1</u>					
The sun is the earth's chief source of energy.					
<u>Subconcept #1</u>					
Light energy from the sun can be changed to heat energy.					☐ <i>How the Earth's Movements Affect Us</i> S.V.E. PK4274 with record
<u>Process Skills Emphasized</u>					
Observing, inferring, communicating	1. Use a magnifying glass in the bright sunlight to burn tissue paper.	T-5 S-3			☐ <i>Plants Needs</i> E.B.F. 9431
Communicating, inferring	2. Discuss sun cookers. Make a solar reflector or a solar still.	S-4			☐ <i>Parts of a Plant and What They Do</i> E.B.F. 9433
Communicating, inferring	3. Find out about solar houses. Make a solar heater.	S-5			☐ <i>Light, Heat and Sound</i> 425-6 S.V.E.
Observing, inferring, hypothesizing, experimenting	4. Put a little water in the bottom of a test tube. Clamp the tube to a support. Place a cork lightly in the tube. Focus sunlight through a large magnifying glass on to the water.				☐ <i>The Sun and Its Energy</i> A409-3 S.V.E.
<u>Subconcept #2</u>					
Heat energy, a result of transformation of light energy, may be used to do work.					☐ <i>What is Heat?</i> J.H.
<u>Process Skills Emphasized</u>					
Observing, communicating	1. Stand in the sun for awhile. How do you feel?	T-5			☐ <i>Where Do We Get Heat?</i> J.H.
					☐ <i>Light and Heat Gateway</i>

Examples of Possible
Activities and Investigations Instructional Materials

		C.I.S.	S.M.A.	S.T.W.	MEDIA
Observing, communicating	2. On a hot day try to cook an egg on the sidewalk.	T-5			⊞ <i>Energy and Work</i> E.B.F.
Observing, inferring, communicating	3. Place a bare foot on a hot sidewalk or on a sandy beach on a real hot day. How does it feel?	T-5 S-11			
<u>Subconcept #3</u>					
Light and heat are two forms of energy.					
<u>Process Skills</u> <u>Emphasized</u>					
Observing, inferring, communicating, interpreting data	1. Discuss how the classroom feels when the sun has been streaming in all day. Why does it feel warm? Where does the heat come from? What happens at night and on cloudy days?	T-5,6			
<u>Subconcept #4</u>					
Heat energy is the sum of all the motions of molecules in a substance.					
<u>Process Skills</u> <u>Emphasized</u>					
Observing, inferring, interpreting	1. Take a cup of hot tea and a cup of cold tea. Put a level teaspoon of sugar into each, but do not stir. Wait one minute; then taste each one. Which tastes sweeter?		T-95- 96 S-187		
Communicating, interpreting	2. Have pupils read p. 184-186 of S.M.A. Let them		S-184 -186		

Examples of Possible
Activities and Investigations Instructional Materials

		C.I.S.	S.M.A.	S.T.W.	MEDIA
	describe Thompson's experiment and tell what his conclusions led him to believe.				
Observing, interpreting	3. Watch the liquid in a thermometer when the thermometer is placed over a register. What happens? How do you explain this?	T-7			
Quantifying, interpreting data	4. Take the temperature in the sun and in the shade and compare. Explain the difference in terms of molecular motion.	T-7 S-7			
<u>Subconcept #5</u>					
As the earth revolves around the sun, the earth receives different amounts of heat.					
<u>Process Skills Emphasized</u>					
Formulating models, experimenting	1. Use a globe and flashlight or lamp to review day and night.	S-8		S-37-38	
Formulating models, experimenting	2. Use a mobile models to show the earth's positions at different times of the year.	S-10			
Communicating, inferring	3. Discuss the types of climate at different times of the year.	S-9			
Quantifying, interpreting data	4. Keep a record of daily temperatures at certain times of the day for a month.	T-8			

Examples of Possible
Activities and Investigations Instructional Materials

		C.I.S.	S.M.A.	S.T.W.	MEDIA
<u>Subconcept #6</u>					
Light energy as it speeds up the motion of the molecules of which matter is composed is changed to heat energy.					
<u>Process Skills</u> <u>Emphasized</u>					
Interpreting, communicating	1. What happens when the sun shines on a pan of water or on air?	T-8 S-11, 12			
Interpreting, communicating	2. Explain why wet clothing dries in the sunshine?		S186-188		[] <i>The Seasons</i> P. 13 [] <i>Day and Night</i> P. 12 [] <i>Solar Energy</i> P. 2
<u>Subconcept #7</u>					
Green plants use energy from the sun to make food.					
<u>Process Skills</u> <u>Emphasized</u>					
Hypothesizing, experimenting, testing, controlling variables	1. Investigation with green plants. Two of 4 healthy plants are placed in a cupboard for a week while two are placed in the light.	S-13 T- 9			[] <i>Types of Satellites</i> P. 17 [] <i>T104 The Solar System and Space Travel</i> Milliken
Hypothesizing, experimenting, testing, controlling variables	2. Investigation with green leaves and sunlight.	T- 9 S-15			
Hypothesizing, experimenting, testing, controlling variables	3. Investigation using three plants.		T-24 S-34		[] <i>Sun and Earth Seasons</i> P. 1 from <i>T203 Seasons and Living Things</i> Milliken

Examples of Possible
Activities and Investigations Instructional Materials

		C.I.S.	S.M.A.	S.T.W.	MEDIA
<u>Subconcept #8</u>					[] <i>Photo-synthesis</i> P. 5 <i>Milliken Transparency Book T 107</i>
Green plants depend on energy from sunlight.					
<u>Process Skills Emphasized</u>					
Inferring, interpreting	1. Lift a stone or a board and observe the grass under it. What is it like? Explain why.	T-10			
Hypothesizing, experimenting, testing	2. Do the investigation with the two foil pans each containing some water, a sponge, and four bean seeds. Place one in a dark cupboard and one in the sunlight.	T-10 S-17			
Inferring, communicating	3. Describe what the earth would look like if there were no light from the sun or what would happen if the sun were to cease shining tomorrow.	T-10			
<u>Subconcept #9</u>					
Animals are dependent upon green plants for food.					
<u>Process Skills Emphasized</u>					
Inferring, communicating	1. Present some empty food cartons and cans. Trace foods back to where each is made.	T-11 S-18-21		S158 159 160	

		C.I.S.	S.M.A.	S.T.W.	MEDIA
Inferring, formulating models	2. Make charts showing the origin of bread, milk, eggs, meat, cake, etc.				
<u>Subconcept #10</u>					
Animals depend on energy that is captured and stored by green plants in the form of food.					
<u>Process Skills Emphasized</u>					
Communicating, investigating	1. Think of some animals which live in dark caves, deep dark parts of the oceans, or in the ground, or in trees. What do these animals eat? Do they depend on sunlight?	T-11			
Communicating, investigating	2. Read to verify your ideas.	S-18-19			
<u>Subconcept #11</u>					
Animals and people, no matter where they live, depend on green plants.					
<u>Process Skills Emphasized</u>					
Predicting, investigating	1. Ask about animals other than those suggested above. Amphibians, reptiles, birds, mammals, insects, etc. Where does their food come from?	T-12			
Inferring, interpreting	2. Ask about animals of long ago - dinosaurs, saber-toothed tigers, etc.	T-12			

Examples of Possible
Activities and Investigations Instructional Materials

		C.I.S.	S.M.A.	S.T.W.	
Formulating models, investigating	3. What about people? Make a class chart of the origin of the supper (lunch or breakfast) which a child ate the previous day.	T-11 S-20		S-160	
<u>Subconcept #12</u>					
The sun's radiant energy can be converted into other forms of energy.					
<u>Process Skills</u> <u>Emphasized</u>	1. Provide each student with a pinwheel. Ask him to examine it and show how he can make it turn: Pushing, running, blowing, falling water, etc. Where did the energy come from? Trace it back to the sun's radiant energy.	T-13			
Observing, interpreting					
<u>Subconcept #13</u>					
Light from the sun can be changed into mecha- nical energy.					
<u>Process Skills</u> <u>Emphasized</u>	1. Place a radiometer in strong sunlight, or under a lighted lamp. Allow students to speculate on what is causing the spinning. Move the radio- meter in and out of a sunny spot. When does it spin fastest? Pass a cardboard sunshade back and forth over it. Why does it stop spinning?	T-13 S-22			
Observing, inferring, interpreting					

Examples of Possible
Activities and Investigations Instructional Materials

		C.I.S.	S.M.A.	S.T.W.	MEDIA
<u>Subconcept #14</u>					
Energy from the sun can be changed to heat energy.					
<u>Process Skills Emphasized</u>					
Observing, inferring, interpreting	1. Observe the water in the fish bowl day after day. What is happening? What kind of energy makes it happen? Where does the energy come from?	S-28			
Inferring, interpreting	2. What happens if you lie out on the beach too long? What kind of energy causes the burn? Where does the energy come from?				
Predicting	3. What causes a snowman to melt?	S-29			
<u>Subconcept #15</u>					
Energy from the sun can be changed to other forms of energy, including electrical energy.					
<u>Process Skills Emphasized</u>					
Communicating, interpreting	1. Ask students to describe the kinds of radios to which they listen. Where does the energy come from to make our radios play?	T-13			
Predicting, interpreting data	2. If no persons mention a radio with solar cells, ask them to find out about this new kind of radio. What makes it play? Where does the energy come from? What enables the radio to use energy right from the sun?	T-13 S-23-24			

Examples of Possible
Activities and Investigations Instructional Materials

		C.I.S.	S.M.A.	S.T.W.	MEDIA
Predicting	3. Where is it very important to be able to use energy right from the sun? (In space).	T-14			
Communicating, investigating, interpreting data	4. Students report on Telestar and Vanguard I telling what they they do and where they get their energy.	S-25-26			
<u>Concept #2</u>					B <i>Kinds of Energy</i> McGraw Hill
Energy can be changed from one form to another.					B <i>Man's Search for Energy</i> McGraw Hill
<u>Subconcept #1</u>					B <i>Light, Heat and Sound</i> S.V.E. 425 #6
To cause movement, energy is required.					B <i>What is Magnetism?</i> J.H. #5 of 1075
<u>Process Skills Emphasized</u>	1. Place a pan of water on the floor. When the water is completely still, put a toy boat on it. How can we make the boat move without touching or blowing on it?	T-20, 21 S33			B <i>Magnetism and Electricity</i> S.V.E. 425-5
Inferring, experimenting					B <i>Understanding Electricity: Electromagnets and How They Work</i> J.H. PK 3602
<u>Subconcept #2</u>					
Water in motion has kinetic energy which can be used to do work.					
<u>Process Skills Emphasized</u>	1. Make moving water turn a wheel as outlined in the investigation.	T-21 S-34			
Observing, experimenting					
Inferring, communicating	2. Relate this experience to the old fashioned mill.	S-36			

Examples of Possible
Activities and Investigations Instructional Materials

		C.I.S.	S.M.A.	S.T.W.	MEDIA
Inferring, communicating	3. How is the energy of moving water used in big dams?	S-37-40			<i> B Finding Out How Foods Are Used in Your Body S.V.E. </i>
Observing, interpreting results	4. Arrange a class visit to a dam.				
<u>Subconcept #3</u>					
Energy from the sun is transformed to heat energy which makes air move.					<i> B Electro-magnets McGraw Hill PK 3861 </i>
<u>Process Skills Emphasized</u>					
Observing, predicting, interpreting	1. Do the investigation outlined in C.I.S. using moving air.	S-44			<i> B Using Electricity Safely J.H. PK 3604 </i>
Observing, interpreting	2. Observe tissue strips held in a current of rising air.				<i> B Finding Out How Foods Are Used in Your Body S.V.E. A424-19 </i>
<u>Subconcept #4</u>					
The kinetic energy of moving air (wind) is used to do work.					<i> B Energy At Work E.B.F. </i>
<u>Process Skills Emphasized</u>					
Interpreting data	1. What causes winds?				<i> B Wind and What It Does E.B.F. </i>
Interpreting data	2. What makes the air move?				<i> B Energy Does Work C.F. </i>
Communicating	3. List the different ways in which wind helps us.	S41-43			<i> B Electricity. How to Make a Circuit E.B.F. </i>
Formulating models	4. Collect pictures of wind helping us.				

Examples of Possible
Activities and Investigations Instructional Materials

		C.I.S.	S.M.A.	S.T.W.	MEDIA
<u>Subconcept #5</u> Chemical energy stored in fuel can be released by burning.					↗ <i>Electro-magnets</i> McGraw Hill
<u>Process Skills</u> <u>Emphasized</u> Observing, inferring, predicting	1. Pupils examine unlit candles. Is there any energy in them? Give reasons for your answer. Light the candles. Feel the heat and light. What has happened?	T-24			
<u>Subconcept #6</u> Released energy can make things move - hence do work.					
<u>Process Skills</u> <u>Emphasized</u>					
Following instructions	1. Do the investigation suggested on page 48 of C.I.S.	S-48			
Observing, interpreting	2. Obtain some Christmas Angel Chimes and observe what happens when the candles are lighted.	S-49			
<u>Subconcept #7</u> Fuels give off heat and light energy when they burn.					
<u>Process Skills</u> <u>Emphasized</u> Observing, classifying, inferring	1. In the above investigations what kind of energy warmed the air? What two kinds of energy do we get when the candle burned? What had to happen before	T-25 S49			

Examples of Possible
Activities and Investigations Instructional Materials

		C.I.S.	S.M.A.	S.T.W.	MEDIA
<u>Subconcept #8</u> Energy is stored by plants and animals that grow in the sunlight. <u>Process Skills</u> <u>Emphasized</u> Predicting, communicating, hypothesizing, questioning <u>Subconcept #9</u> Food (like fuel) has stored (potential) energy. Stored energy in food changes to other forms of energy. <u>Process Skills</u> <u>Emphasized</u> Observing, inferring Observing, inferring, interpreting Observing, inferring	the energy was given off? What happens when the candles are blown out? 1. Do you make energy when you burn a candle? How is energy stored in the wax of the candle? Why do scientists <u>think</u> that petroleum comes from the plants and animals of long ago? Why aren't they sure? 1. In what way are we like automobiles? 2. Take your temperature. Why is it warmer than the room around you? 3. Breathe on your hand. Is the air warmer or cooler than that around you? Where does the heat in your body come from?	T-26 S50- 52 T-27 S-54			

Examples of Possible
Activities and Investigations Instructional Materials

		C.I.S.	S.M.A.	S.T.W.	MEDIA
Observing, predicting	4. Burn a butter candle or place a shelled peanut on a wire, hold heat under it. Hold a plate over the flame. What is on it? What color are the remains?	S55			
<u>Subconcept #10</u>					
Energy from food may be used by the body for growth and to do work.					
<u>Process Skills</u> <u>Emphasized</u>					
Quantifying, hypothesizing	1. Were you once much smaller than you are now? Will you someday be bigger? What makes you grow?	T27			
Communicating, observing	2. Discussion - Will you someday stop growing completely? Will some parts of you keep on growing or changing even when you are big?	T28			
Observing, hypothesizing	3. Think of all the moving your body does in a day. Does it do any moving while you sleep? What helps you move?	S56, 57			
Communicating, classifying	4. Make a collection of pictures of good energy foods.	S58			
<u>Subconcept #11</u>					
Stored chemical energy in a dry cell can be changed to electrical energy.					From Milliken Transparencies T106: [] <i>Electric Current and Magnetism</i> P. 6

Examples of Possible
Activities and Investigations Instructional Materials

		C.I.S.	S.M.A.	S.T.W.	MEDIA
<u>Process Skills</u> <u>Emphasized</u> Observing, predicting , experimenting	1. Allow students to study flashlights. How do you turn them on? Study the bulbs. What are they like? Where is the electricity coming from? Take the flashlight apart. Study the parts. Which part supplies the energy? How can you prove your answer?	T29 S60			
<u>Subconcept #12</u> Electric energy can be used to make things move (to do work).					
<u>Process Skills</u> <u>Emphasized</u> Observing, inferring	1. Take a record player, an electric clock, or a closed electric fan. How can you make these move? Where is the energy coming from?	T28			
Predicting, experiment- ing	2. Do the investigation from C.I.S. page 61. How can you make the electro-magnet stronger?	S-61 S-62 S-63			
Observing, classifying	3. Take an old telephone or electric bell apart. Look for the electro magnet.	T-32			
<u>Subconcept #13</u> Electric energy flows through a circuit.					

Examples of Possible
Activities and Investigations Instructional Materials

		C.I.S.	S.M.A.	S.T.W.	MEDIA
<u>Process Skills</u> <u>Emphasized</u> Observing, making operational definitions <u>circuit</u> , hypothesizing	1. Study an electric bell. Find the turns of wire. Make an electric bell ring by connecting it to a dry cell. Explain what is happening. What happens if you unfasten one wire?	T31, 32 S64, 65, 66			[] <i>Electro- magnets P. 7</i> [] <i>Wet and Dry Cells P. 12</i> [] <i>The Pathway of Electricity Circuits P. 15</i> [] <i>Switches and Fuses P. 17</i> [] <i>Kinds of Magnets P. 1</i>
Formulating models Classifying, quanti- fying	2. Make a light switch. 3. Make a collection of elec- tric light cords,insulate outdoor electric wire, plugs, sockets, switches, etc. for an exhibit.				
<u>Subconcept #14</u> Energy of motion (as resulting from electric energy) can be used to do work.					
<u>Process Skills</u> <u>Emphasized</u> Formulating models, experimenting Observing, classifying, communicating	1. Make and use an electric motor. 2. Investigate at home and report which of the following have electric motors: an electric clock, and electric razor, an electric beater, a toaster, and electric tooth- brush, etc.	T-32 S67 S69			

GRADE III

CONCEPTUAL SCHEME B

When matter changes from one form to another, the total amount of matter remains unchanged.

SUGGESTED MATERIALS AND EQUIPMENT

weighing scale, large plastic jar, ice cubes, pyrex cooking pan, electric grill, thermometers, rubbing alcohol, vinegar, mouthwash, after-shave lotion, vanilla, lemon extract, wads of absorbent cotton, perfume (colored), mothballs (12), large glass bottles, glasses (tumblers), baking soda, dry ice (several pieces), tongs, sugar (lump - 1 lb.) (granulated - 5 lb.) (powdered - 1 lb.), salt - 1 container, glass jars, teaspoons, measuring cups, atom models, clean water, metal cooking pans, shallow pans, cotton string, clean bolts or screws, rulers, magnifying lenses, plastic jars (6), black paper, metal pie pans, hot dish holders, 1 box cornstarch, 10 pennies, iron filings, sheets of paper (12), magnets (7-12), carbon, paper napkins, pint milk cartons, paper napkins, large nails, clean sand, coffee grounds, instant coffee, cocoa, powdered chalk, dry milk, cinnamon, etc. scissors, silver spoons, hard-boiled eggs, silver polish, writing paper, rocks (small pieces), aluminum, zinc, copper, iron, iodine, mercury, nickel, milk, vinegar, instant tea, toothpicks, gum drops, dextrose, powdered starch, copper sulfate, filter paper.

SUPPLEMENTARY REFERENCES

- Freeman, Mae and Ira, *The Story of the Atom*, Random House, N. Y., 1960.
Freeman, Mae and Ira, *Fun With Chemistry*, Random House, N. Y., 1962.
Carona, Philip B., *The True Book of Chemistry: What Things Are Made of*, Children's Press, Chicago, 1963.
Cooper, Elizabeth K., *Discovering Chemistry*, Harcourt, Brace and World, N. Y., 1959.
Jacobson, W. J., Lauby, C. J., Konicek, R. D., *Changes in Matter*, Thinking Ahead in Science Booklets, American Book Company, N. Y., 1965.
Smith, Belcha, and Sternig, *Science 3*, Laidlaw Brothers, River Forest, Illinois, 1966.
Landin, Leslie, *About Atoms for Junior*, Melmont Publishers, 1961.
Lewellen, John, *The Mighty Atom*, Alfred A. Knopf Inc., 501 Madison Ave., N. Y., N. Y., 10022, 1965.

RECOMMENDED REFERENCES

Code: C.I.S. - *Concepts in Science* (Longmans)
S.M.A. - *Science, A Modern Approach* (Holt, Rinehart)
S.T.W. - *Science for Tomorrow's World* (Collier, Macmillan)

Code for Media:

- ▶◀ Films
- ▶◀ 8 Film Loop
- 8 Filmstrip
- ⊙ Records
- Tapes
- [] Slide or Transparencies

NOTE: Top of pages are marked according to grade, conceptual scheme and concept number.

		C.I.S.	S.M.A.	S.T.W.	MEDIA
<u>Concept #1</u>					B All Matter Has Three Forms Y.A.F.
Matter consists of atoms and molecules.					
<u>Subconcept #1</u>					B Finding Out About Heating Solids, Liquids, and Gases. S.V.E.
In physical change, such a change of state, the amount of matter taking part remains unchanged.					
<u>Process Skills Emphasized</u>					B Some Things Dissolve McGraw-Hill
Observing, predicting, quantifying, interpreting	1. Melt ice and compare weight of water as a solid and as a liquid.	T 56			
Observing, predicting, quantifying, interpreting	2. Repeat the above using milk instead of water.	S 111			B Understanding Chemical Change McGraw-Hill
<u>Subconcept #2</u>					B Elements, Compounds, and Mixtures A493-2
In physical change, the amount of matter taking part remains unchanged.					
<u>Process Skills Emphasized</u>					B Hydrogen, Oxygen, and Water A493-
Quantifying, predicting, formulating hypothesis, interpreting data	1. Pour exactly one cup of water into an ice tray. Put tray in the refrigerator freezer for several hours. Remove the tray. Allow ice to melt. Would you expect to get exactly the same amount of water when you pour it back into the cup? Check to determine the answer.				B How Does Water Get Into the Air? PK3676

Examples of Possible
Activities and Investigations Instructional Materials

		C.I.S.	S.M.A.	S.T.W.	MEDIA
Quantifying, making operational definitions, interpreting data	2. Repeat the above using milk instead of water.				
Observation, experimenting	3. Do the investigation - A Fast Way to Change Water from a Solid to a Gas.	S-113 T-57			
Predicting, experimenting	4. Draw from students suggestions how to set up an experiment to change water from a liquid to a gas to a liquid. (distillation)	S-114, 115 T-57			
<u>Subconcept #3</u>					◀ <i>The World of Molecules</i> S.V.E.
All matter remains particulate.					◀ <i>What Are Things Made Of?</i> C.O.R.
<u>Process Skills Emphasized</u>					◀ <i>Heat and How We Use It</i> E.B.F.
Investigating, communicating	1. Using sense of smell, match liquids to bottles they came from - water, pop, vinegar, etc.	T-58	T-79		
Investigating, communicating	2. Finding out about substances. Use of one's senses to tell substances apart.	T-58	T-81, 82 S144- 149		◀ <i>Chemical Changes</i> McGraw-Hill
Observation, critical thinking	3. Investigation to show the evaporation of perfume.	T58 S118- 119			◀ <i>Solids, Liquids, and Gases</i> McGraw-Hill
Observation, critical thinking	4. Investigation - What happens to mothballs?	S119- 120 T59			◀ <i>Composition of Air</i>

Examples of Possible
Activities and Investigations Instructional Materials

		C.I.S.	S.M.A.	S.T.W.	MEDIA
<u>Subconcept #4</u>					
The smallest part of a substance is a molecule.					✧ <i>The Physical Characteristics of Air</i>
<u>Process Skills Emphasized</u>					
Investigating, communicating, defining terms	1. Find out about molecules. What is a molecule? What is a molecule made up of?	SI21 SI28			✧ <i>Air Around Us</i> E.B.F.
Formulating models	2. Make models and diagrams to illustrate simple molecules - water, oxygen, hydrogen, sugar. (Use gum drops, etc.)	SI21 SI28			✧ <i>Things Dissolve</i> McGraw-Hill
Observing, interpreting	3. Examine differently shaped bottles containing solids, liquids, and gases. Differentiate between the three states.	SI22			✧ <i>Simple Changes in Matter</i> C.O.R.
Observing, interpreting	4. Do the demonstration with dry ice.	T59	SI72		
Inferring, predicting, experimenting	5. How does our sense of smell give evidence of molecules? Our sense of sight?			SI40,41 Bk. 6 SI42,43 Bk. 6	
<u>Subconcept #5</u>					
Substances can dissolve in other substances.					
<u>Process Skills Emphasized</u>					
Experimentation, observation, investigation explanation	1. Dissolve some sugar in water. Why is this possible? What happens?	SI23- 124			

Examples of Possible
Activities and Investigations Instructional Materials

		C.I.S.	S.M.A.	S.T.W.	MEDIA
Defining terms, explaining	2. Find out about the terms "solution" and "dissolving"		S150- 151 S162		
Predicting, investigating	3. Have a series of questions in which students must predict the outcome. a) What will sugar do if put into a glass of lemonade? b) What happens when you make instant coffee or tea? c) Which dissolves more salt - one-half cup of cold water or one- half cup of hot water?	T60 S127	S162- 164 S166		
Predicting, experimenting	4. Test what water does to the three white substances - sugar, starch, and baking soda.		T83 S150		
Predicting, experimenting	5. Can you make a solution of oil and water?		S165		
<u>Subconcept #6</u>					
The state of matter can change, but the amount of matter remains unchanged.					
<u>Process Skills</u> <u>Emphasized</u>					
Observing, hypothesi- zing, investigating, quantifying	1. Do the investigation "Taking Salt Out of a Solution".	S126 T60			

Examples of Possible
Activities and Investigations Instructional Materials

		C.I.S.	S.M.A.	S.T.W.	MEDIA
Observing, investigating, communicating	2. In hot water make saturated solutions of sugar and salt. Pour each solution into a shallow pan. Lay strands of string across the surface to make crystals. Study these.	T61			
Investigating, communicating	3. Find out about chemists and chemistry. How is a chemist's work like that of a detective?	S128		T82 S148	
	4. Can chemists always depend on their senses?				
<u>Subconcept #7</u>					
The application of energy can change the molecular structure of a compound.					
<u>Process Skills Emphasized</u>					
Analyzing, explaining	1. Investigation: Breaking up sugar molecules.	S129 T62-63			
Observing, classifying	2. Find out about the differences between elements and compounds. Make a display of samples of each.	S131- 132			
Observing, predicting, analyzing	3. Break up the molecules of cornstarch and note constituents. Repeat using baking soda. Are any of these substances used in the mixtures used previously? How can you tell?	T63		T83 S152	

Examples of Possible
Activities and Investigations Instructional Materials

		C.I.S.	S.M.A.	S.T.W.	MEDIA
<u>Subconcept #8</u> Solids may be combined to form a mixture. <u>Process Skills</u> <u>Emphasized</u> Critical thinking, communicating Theorizing, communicating, observing Observing, predicting, investigating	1. Make a mixture of sugar and pennies. Pupils should separate the substances. Easily done - no change in the sugar or in the copper. 2. Separate a mixture of iron filings and sugar. Ask students for suggestions. 3. Separate a sugar and sand mixture. Ask for ideas for separating these. Lead up to the use of a filter.	 S134 T64 S135 T64 T64-65 S137	 S162 S164	 	
<u>Subconcept #9</u> A solid and a liquid may be combined to form a mixture. <u>Process Skills</u> <u>Emphasized</u> Observing, investigating	1. Encourage students to make mixtures of a solid and a liquid: Example - coffee grounds and water, instant coffee and water, dry milk and water, cocoa and milk, etc.	 T65	 	 	

[] *Milliken Transparency Book #T-109 Physical and Chemical Changes:*

[] *What is Matter? P. 1*

[] *Properties of Matter P. 2*

[] *Physical Properties of Matter P. 3*

Examples of Possible
Activities and Investigations Instructional Materials

		C.I.S.	S.M.A.	S.T.W.	MEDIA
Predicting, hypothesizing	2. Students suggest ways in which the mixtures could be separated and test these	T65			[] <i>Chemical Properties of Matter</i> P. 4
Formulating models	3. Students make their own filters to use.	T65 S138			[] <i>Atoms</i> P. 5
<u>Subconcept #10</u>					[] <i>Molecules</i> P. 6
Substances in a mixture may be separated.					[] <i>Elements</i> P. 7
<u>Process Skills</u> <u>Emphasized</u>					[] <i>Compounds</i> P. 8
Classifying, inferring	1. Review the ways in which mixtures may be separated.	S137			[] <i>Mixtures and Solutions</i> P. 9
Hypothesizing, investigating, communicating	2. Separate a mixture of chalk and salt.				[] <i>Chemical Reactions</i> P. 12
Hypothesizing	3. Why can you get the same substances back when you separate a mixture?	S139			[] <i>Types of Physical Changes</i> P. 16
<u>Subconcept #11</u>					
A chemical change occurs when the molecules of a substance are broken down into their components.					
<u>Process Skills</u> <u>Emphasized</u>					
Observing, inferring, interpreting data	1. Show some string to the class. How can scissors be used to change the string? Cut string into small bits. Analyze what has happened.				

Examples of Possible
Activities and Investigations Instructional Materials

		C.I.S.	S.M.A.	S.T.W.	MEDIA
Observing, inferring, interpreting data	2. Repeat the above using paper. Have the molecules changed?	T65			
Inferring, predicting	3. What do we have to do to make the molecules change?	T65			
Observing, inferring, hypothesizing	4. Burn the string and the paper. What has happened to the molecules?	Sl41-142			
<u>Subconcept #12</u>					
A change is physical when the molecules of a substance remains unchanged in chemical structure.					
<u>Process Skills Emphasized</u>					
Investigating, classifying, communicating	1. Find out about physical and chemical changes. What is the difference?	T66			
Classifying, interpreting	2. Students give their own examples to test understanding.	Sl43 T66			
Inferring, predicting, interpreting	3. Investigate ways of bringing about physical and chemical change.				
Observing, predicting, interpreting	4. Leave a boiled egg yolk on a silver spoon overnight. What happens?	T66			
Interpreting data, formulating	5. Use charts, exhibits, and demonstrations to show changes in sugar or other substances.	T67 Sl44			

Activities and Investigations Instructional Materials

		C.I.S.	S.M.A.	S.T.W.	MEDIA
<u>Subconcept #13</u>					
Matter exists in various forms and states.					
<u>Process Skills</u>					
<u>Emphasized</u>					
Investigating, critical thinking, classifying	1. Present to the class, a jar of water, chunk of rock and an empty bottle. In what form is each substance?	T67 S145			
Critical thinking	2. What do these substances have to do with our lives?				
Defining terms	3. Review compounds and elements.				
Investigating, communicating	4. Find out about the water cycle and its importance. Demonstrate changes in the state of water. (Evaporation, condensation, solidification)	T67	S174 175		
<u>Subconcept #14</u>					
Matter can change in form or state.					
<u>Process Skills</u>					
<u>Emphasized</u>					
Inferring, predicting, communicating	1. By discussion bring out ideas about the earth's solid part - mainly rock. Does the rock part ever change?	T68		S67-69 T16	

Examples of Possible
Activities and Investigations Instructional Materials

		C.I.S.	S.M.A.	S.T.W.	MEDIA
Inferring, predicting, communicating	2. Consider the earth's air blanket. What is it made up of? Is air matter? Explain.	T68			
Investigating, reporting	3. Find out about space exploits related to solid, liquid, and gaseous sub- stances beyond the earth.	T68			
Formulating models, communicating	4. Arrange exhibits and give talks to other classes, parents, etc.	T69-70			

GRADE III

CONCEPTUAL SCHEME C

Living things are interdependent with one another and with their environment.

SUGGESTED MATERIALS AND EQUIPMENT

cans (food containers), cartons, wrappers from foods, 5 or 6 cups clean sand, 5 or 6 lumps of wet clay, 5 or 6 cups gravel or pebbles, white paper, 15 cups good topsoil, 30 magnifying lenses, 3 cups garden soil, 2 clear glass jars, pyrex pan with lid, milk cartons for filters, paper towels, electric hot plate, large glass pie pans, 12 small flower pots (filled with good topsoil), 4 packages radish seed, 6 sponges, 6 pans of water, 6 empty coffee cans, 6 glass containers to go under them, hammer, large nail, 6 measuring cups, 6 cups of each of these: sand, topsoil, rich humus, cactus or desert plants, hot water, Easter egg dye (tablets - 6 red - 6 blue), bunch of radishes, stalk of celery (with a few pale leaves), red ink, blue ink, 6 geraniums - daisies or carnations, 30 small pots, 30 one-half pint cartons, 30 cups clean sand, 30 cups good topsoil, 8 packages flower seeds: zinnia - marigold - nasturtium, etc., 1 large bottle of commercial plant food, 1 globe, ivy plants, beets, carrots, parsnips, turnips, sweet potatoes.

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RECOMMENDED REFERENCES

Code: C.I.S. - *Concepts in Science* (Longmans)
S.M.A. - *Science, A Modern Approach* (Holt, Rinehart)
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- [] Slide or Transparencies

NOTE: Top of pages are marked according to grade, conceptual scheme and concept number.

Examples of Possible
Activities and Investigations Instructional Materials

		C.I.S.	S.M.A.	S.T.W.	MEDIA
<u>Concept #1</u>		T74 S153			
There are characteristic environments, each with their characteristic life.	Introduce the scheme by discussing the meaning of treasures. What are some treasures that come out of the earth? What are the earth's greatest treasures?				B <i>How Soil is Formed</i> McGraw-Hill B <i>Soil is for Growing</i> McGraw-Hill B <i>How a Plant Grows</i> McGraw-Hill B <i>How a Plant Makes Food</i> McGraw-Hill B <i>Plant Life of the Desert</i> E.B.F.
<u>Subconcept #1</u>					
Plants and animals depend on matter in the environment for growth.					
<u>Process Skills</u> <u>Emphasized</u>					
Communicating, inferring	1. How were foods secured by the early pioneers and the native Indians?	T74			
Interpreting, inferring, communicating	2. Compare these methods with our own supermarket ways of obtaining foods.	T74			
Observing, classifying, communicating	3. Collect and examine food cartons, tins, and wrappers. Where do these foods come from before they reach the supermarket?	T74			
Inferring, predicting, communicating	4. Read the accounts of visits to a cattle ranch, a wheat farm, a chicken farm, and a dairy farm. Discuss the foods supplied by each.	S154- 158			
<u>Subconcept #2</u>					
Some plants live together, two-in-one, and help each other.					

Examples of Possible
Activities and Investigations Instructional Materials

		C.I.S.	S.M.A.	S.T.W.	MEDIA
Observing, classifying, predicting	2. Then allow each child to study some gravel and some clay. Are these broken up rock materials? Are they the same as soil or is soil different?	T75			
Observing, classifying, interpreting data, defining terms	3. Let each student examine 1 cupful of soil spread out on a paper. Put each kind of material into a separate pile. At the end combine the materials on two separate sheets. One containing materials from <u>Rocks</u> ; the other materials from <u>Living Things</u> . Introduce the word <u>humus</u> .	T76 S159, 160			
<u>Subconcept#5</u>					
Matter, in soil, is composed of three states. Soil contains materials for plant growth.					
<u>Process Skills</u> <u>Emphasized</u>					
Inferring, hypothesizing, experimenting, interpreting data	1. Is there water in soil? Ask students how they could prove this. Then investigate by heating a cup of garden soil in a pyrex pot covered by a lid. What happens? Explain.	T76 S161			
Predicting, hypothesizing, interpreting data	2. Is there air in soil? Put some garden soil in a jar and some water in a second jar. Slowly add water to the jar containing the	T76 S162			

Examples of Possible
Activities and Investigations Instrucitonal Materials

		C.I.S.	S.M.A.	S.T.W.	MEDIA
Predicting, investigating, interpreting data	soil until the jar is full. Stir the mixture and let it stand. What do you notice? Explain what happens. 3. Is there anything in soil that dissolves in water? How can we find out? Mix some soil and water. Pour it through a filter. Catch the liquid and pour it into a glass pie plate until the water evaporates. Ask class to predict what will happen. What is on the pie plate?	T77 S163			Milliken T201
<u>Subconcept #6</u> Various soils have differing capacities for the retention of water. <u>Process Skills Emphasized</u> Observing, inferring, interpreting data	1. What is a sponge? Allow students to find out how water is held in a sponge. Try different kinds of sponges. In what way is soil like a sponge? 2. What kind of soils hold water best? Prepare three coffee cans by making six equal sized holes in the bottom of each. In the first can place one cup of	T77 S165			[] <i>Kinds of Plants</i> # 1 [] <i>Parts of Plants</i> # 2 [] <i>What Plants Need to Grow</i> # 6 [] <i>What We Get From Plants</i> # 7 [] <i>Plant Growth and Change</i> # 8 [] <i>Trees</i> # 9
Hypothesizing, experimenting, interpreting data, controlling variables		T78 S166- 167			

Examples of Possible
Activities and Investigations Instructional Materials

		C.I.S.	S.M.A.	S.T.W.	MEDIA
	sand , in the second one cupful of garden soil, and in the third one cup of humus. Label the cans and place each one over a glass jar. Add exactly one cup of water to each can of soil. From which can does the water drip first? From which can did the water stop dripping first? Which held water for the shortest time? The longest time? Which is the best soil for holding water? The poorest? (Allow for different kinds of garden soils.)				Milliken T107 [] <i>Plants</i> # 3 [] <i>Bacteria, Algae, and Fungi</i> # 4 [] <i>Photosynthesis</i> # 5 [] <i>Ferns and Mosses</i> # 6 [] <i>Flowering Plants</i> # 7 [] <i>Plant Parts and Functions: Roots and Stems</i> # 8 [] <i>Leaves and Flowers</i> # 9
<u>Subconcept #7</u> All plants require water for life. <u>Process Skills Emphasized</u> Inferring, interpreting	Soil in the Woods and on the Deserts: 1. Students discuss experiences (first hand or via books, films or television) to review the concept of each type of environment: kind of soil, amount of plant growth, kinds of plants, special adaptations	T78 S168- 170			
Inferring, interpreting data	2. Cut open the thick, pulpy stem or leaf of a cactus plant. Why do you think this pulpy inside helps the plant? (Stores water)		T23 S30	Book 6 S246 247 S252	

Examples of Possible
Activities and Investigations Instructional Materials

		C.I.S.	S.M.A.	S.T.W.	MEDIA
Inferring, predicting, interpreting <u>Subconcept #8</u> There is flow of materials between living things and their environment. <u>Process Skills</u> <u>Emphasized</u> Observing, experimenting, interpreting data	3. Notice the different kinds of house plants at home. Report on those which need most water. Explain why plants need water.				
	1. Mix crushed Easter egg-dye tablets with sand. Place the mixture in a filter can. Pour hot water over the mixture. Notice the color of the liquid that comes through the filter. What happened? Molecules of dye mixed with molecules of water to form a solution. In a similar way soil water dissolves minerals.	T79			
Observing, defining terms, predicting	2. How do mineral solutions get into the plants? Give each child a radish seedling, a mature radish, and a magnifying glass. Identify roots, rootlets and root hairs. What do they do for the plant?	T79 S171- 172	T21 S24		

Examples of Possible
Activities and Investigations Instructional Materials

		C.I.S.	S.M.A.	S.T.W.	MEDIA
Observing, classifying (comparing)	3. Study the roots of grass, weeds, carrots, beets, etc. Compare these with radishes.	T79-80 S175	T20 S16		
	4. Make root gradens by placing a beet, carrot, turnips, and parsnip in a glass dish filled with gravel. Add water so that the ends of the roots are covered.		T20-21 S17,18 19,20		
	5. Do plants need roots? Do the activities in S.M.A.		S21,22 23,24		
Observing, hypothesizing, interpreting data	6. Place a stalk of celery in a solution of dye and water. What happens? Explain why. (Set in the sun to speed up activity)	T80 S173	S25 T22		
<u>Subconcept #9</u>					
Minerals travel from regions of greater concentration to regions of lowest concentration.					
<u>Process Skills</u> <u>Emphasized</u>					
Predicting, hypothesizing, experimenting	1. Label three pots of previously prepared radish plants. #1 is to receive no water, #2 is to be kept damp, and #3 is to be kept filled with water at all times. Ask children to predict how the investigation will turn out. Why?	T80 S174	T21		
	2. Find out what happened in C.I.S. book.				

Examples of Possible
Activities and Investigations Instructional Materials

		C.I.S.	S.M.A.	S.T.W.	MEDIA
Deferring judgment, explaining variables	3. Account for any discrepancies in the class experiment.				
Experimenting, formulating models	4. Let pupils experiment making flowers of different colors - (a blue geranium from a white one, a green carnation, a red daisy, etc) by inserting stems in different solutions.	T80	S26		
<u>Subconcept #10</u>					
Living things need a suitable environment for growth.					
<u>Process Skills</u> <u>Emphasized</u>					
Hypothesizing, planning an experiment, deferring judgment and conclusions	1. Let children pair off. Each pair needs two containers - one for white sand - one for garden soil. Plant 4 seeds of the same kind in each container. Keep the soil moist. Keep planters together in pairs. Some pairs may be placed on the floor, some on a window sill, some in a shady corner, some outdoors, etc. Once planters are in place, allow students to speculate. Are we sure how the investigation will turn out? Explain that sand is not always poor in substances that plants need.	T81 S176			

Examples of Possible
Activities and Investigations Instructional Materials

		C.I.S.	S.M.A.	S.T.W.	MEDIA
Inferring, predicting	2. Can plants grow in the same soil year after year? Do soils become poor?	T82			
Investigating	3. Find out how poor soils can be made better. (legumes, summer fallow, crop rotation, fertilizers)	S177-179			
Investigating, observing	4. Use fertilizer on one of two of the above pots which contain poor plants.			S213-215	
Observing, investigating, interpreting data	5. Study a globe. Find out where most of the world's people live. (On a layer of soil in which plants can grow.)	T82-83			
Conceptualizing	6. Refer back to the introduction. What is the earth's greatest treasure? Why?	S180-181			
	7. What would it be like without soil?		T55		
	8. Do plants grow better in some soils than others? Do investigation in S.M.A.		S98-99		

GRADE IV

CONCEPTUAL SCHEME A

When energy changes from one form to another, the total amount of energy remains unchanged.

SUGGESTED MATERIALS AND EQUIPMENT

tissue paper, combs, rubber bands, pie pans, soda straws, nails, hammer, "slinky" toy, tuning forks, rope, perfume, plastic dishes, pail, mirrors, test tubes, electric light, pennies, aquarium, matches, candles, jars, polarizing filters, tumblers, ice, balloons, tape, red and blue coloring (ink), apples, potatoes, plastic bags, funnels.

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Examples of Possible
Activities and Investigations Instructional Materials

		C.I.S.	S.M.A.	S.T.W.	MEDIA
<u>Concept #1</u>					
A loss or gain of energy affects molecular motion.					⊞ <i>Finding Out About Sounds</i> S.V.E. ⊞ <i>Sounds We Hear</i> S.V.E. ⊞ <i>Vibrations</i> E.B.F.
<u>Subconcept #1</u>					
Sound is caused by a vibrating object.					
<u>Process Skills Emphasized</u>					
Observing, interpreting data, inferring	1. Have pupils place tissue over a comb and hum with their lips against the tissue. What happened? Can you feel the vibrations?	P4-8		TL72-176	<i>Elementary Teacher's Classroom Science Demonstration and Activities</i> D. Hennessy (Prentice-Hall) P. 288-296
Observing, interpreting data, inferring	2. Stretch a rubber band around a pie tin. Pluck the rubber band with a finger so that it makes a sound. What does the band do while you hear the sound?				<i>How and Why Wonder Book of Sound</i> P. 7-8
Observing, interpreting data, inferring	3. Strike a note on an instrument. What is happening? Why? Feel the air directly above the string as it vibrates.				<i>Your World of Motion</i> P. 118
<u>Subconcept #2</u>					
The pitch of sound depends upon the rate (frequency) of the vibration.					⊞ <i>Sound</i> E.B.F. ⊞ <i>Finding Out About Sounds</i> S.V.E.

Examples of Possible
Activities and Investigations Instructional Materials

		C.I.S.	S.M.A.	S.T.W.	MEDIA
Formulating models	3. Lay a piece of rope out straight on the floor. Take one end of the rope and move it quickly up and down until a wave motion is set up.				<i>Energy in Waves Ch. 3</i>
<u>Subconcept #4</u>					
The molecular theory explains the behavior of a sound in a solid, liquid, and gas.					
<u>Process Skills</u> <u>Emphasized</u>					
Observing, inferring	1. Put a few drops of perfume on a saucer. How does it spread to the children? Relate to sound using ideas of molecules.	T11-13		T179-180	
Observing, interpreting data	2. Students put head (with ear downward) on one side of desk and then tap gently on the other side of desk. They then lift heads above desk level (but in the same relative position) and tap gently again. Have students write down observations and conclusions.				
Observing, inferring, hypothesizing	3. Experiment in bathtub can be done by placing the ear under water and gently tapping two objects together. Then lift ear out of water and repeat.				

Examples of Possible
Activities and Investigations Instructional Materials

		C.I.S.	S.M.A.	S.T.W.	MEDIA
Interpreting data	4. Discussion a few days later. Students generalize that sound travels better in solids and liquids than in gases. Why?				
<u>Subconcept #5</u>					
An echo is caused by the bounce of sound.					⊞ <i>Finding Out About Sound</i> S.V.E.
<u>Process Skills</u> <u>Emphasized</u>					<i>How and Why Wonder Book of Sound</i>
Predicting, communicating	1. Shout into a large pail. What happens?	P13-15		P188-193	<i>Energy in Sound Waves</i> P. 49-50
<u>Subconcept #6</u>					
Some substances reflect sound better than others.					
<u>Process Skills</u> <u>Emphasized</u>					
Observing	1. Make two clapping sticks and test clapping sounds against various substances (wooden walls, cement walls, etc.)				
<u>Subconcept #7</u>					
Objects become visible as light is reflected from them to the eye.					⊞ <i>Light and How It Travels</i> J.H.
<u>Process Skills</u> <u>Emphasized</u>					⊞ <i>Light and What It Does</i> E.B.F.
Observing, interpreting data	1. Have a child enter a dark closet. Give him a pencil. Then ask him what color the pencil is. Will he be able to tell you?	T21-23		T200-202	

Examples of Possible
Activities and Investigations Instructional Materials

		C.I.S.	S.M.A.	S.T.W.	MEDIA
Observing, communicating	2. Hold a mirror to a dark page of a book in the light. What happens to the dark page? Hold a sheet of white paper to a dark page in the light. Hold a sheet of black paper to a dark page in the light. How does light behave?				
Observing, interpreting data	3. Stand a pencil on a sheet of white paper and focus a light on the pencil. Move the light around the pencil. What do you notice about the shadow as the light is moved around the pencil?				
Observing, hypothesizing, interpreting data	4. Arrange five test tubes, two with two shades of red water, two with two shades of blue water and one with clear water, from lightest to darkest. Place a piece of brightly colored paper at the far end of a shoe box. Direct a flashlight through a hole in the top of the box. Look at the test tubes, then look at the colored paper inside the shoe box through a hole in the other end of the box. What colors do you see?				
<u>Subconcept #8</u> Light, sound and electricity are different forms of energy.					B <i>Light and How It Travels</i> J.H.

Examples of Possible
Activities and Investigations Instructional Materials

		C.I.S.	S.M.A.	S.T.W.	MEDIA
<u>Subconcept #10</u> Light energy may be released by a chemical change. <u>Process Skills</u> <u>Emphasized</u> Interpreting data Predicting, inferring Inferring, interpreting data, defining terms	1. Use the striking of matches to show that a chemical reaction produces light. 2. Mark inches and half inches on a candle with a pencil and ruler. How long does it take for half an inch of paraffin to disappear? What happens to the paraffin? How long would it take for the entire candle to burn? 3. Stick a short candle in the bottom of a jar with melted wax. Blow out the flame and pour about an inch of clear limewater into the jar. Light the candle. Place a second dry jar over the mouth of the first jar. What happens to the flame? Join the jars together with tape, not letting air in. Shake the chamber gently to mix the limewater and the air. What happens to the limewater?	T27-29			<i>Energy In Waves</i> Ch. 5

Examples of Possible
Activities and Investigations Instructional Materials

		C.I.S.	S.M.A.	S.T.W.	MEDIA
<u>Subconcept #11</u> Light energy behaves sometimes as waves, sometimes as particles <u>Process Skills</u> <u>Emphasized</u> Predicting, inferring	1. Look through a piece of polarized plastic. Does light pass through? Place one piece on the other and look through both. Does light pass through now? Turn one of the pieces holding the other one still. What happens as one of the pieces is turned?	T30- 31			
<u>Subconcept #12</u> Heat causes water to evaporate and to become a gas. <u>Process Skills</u> <u>Emphasized</u> Inferring	1. Put a drop of perfume on a dish and leave it for a few minutes. Put a drop of water on a dish. Where do the drops go?	P66- 70			
Observing, inferring, Interpreting data	2. Put a drop of water in a glass. Tape another glass over the first. Let the glass chamber stand in a warm place. What happens to the drop of water?				

		C.I.S.	S.M.A.	S.T.W.	MEDIA
<u>Subconcept #13</u>					
To condense water vapor, heat energy must be taken away.					
<u>Process Skills</u> <u>Emphasized</u>					
Inferring	1. Breathe onto a mirror. Where does the damp spot come from? Where does it disappear to?	T42-43			
Inferring	2. Place ice and cold water in a shiny tin can. What happens to the shiny surface? Where did the water come from?				
<u>Subconcept #14</u>					
As molecules of air and water are heated, their movement increases and they occupy more space.					
<u>Process Skills</u> <u>Emphasized</u>					
Interpreting data, communicating	1. Put a few drops of water in each of two bottles. Put a balloon over each. Place one bottle in a pan of warm water and the other in a pan of cold water. What happens to each balloon? Exchange the bottles and pans. What happens? Why does this occur?				

Examples of Possible
Activities and Investigations Instructional Materials

		C.I.S.	S.M.A.	S.T.W.	MEDIA
Interpreting data	2. Place a pop bottle that is almost full of cold water into a pan of hot water. What do you observe? Explain.				
<u>Subconcept #15</u>					
Rising air cools and its water condenses to form a cloud.					
<u>Process Skills</u> <u>Emphasized</u>					
Interpreting data	1. Pour about an inch of water into a glass. Tape another glass over it. Put the sealed glass chamber on a warm radiator or in a warm place. What happens to the upper part of the chamber?	T44-45			
<u>Subconcept #16</u>					
Rain forms as cloud droplets come together unto larger droplets of water.					
<u>Process Skills</u> <u>Emphasized</u>					
Formulating models	1. Take two large jars. Fill one with cold water and one with warm water. Put some blue ink in a small jar of cold water and red ink in a small jar of warm water. Pour a small	T46-47			

Examples of Possible
Activities and Investigations Instructional Materials

		C.I.S.	S.M.A.	S.T.W.	MEDIA
<u>Subconcept #17</u> Warm water rises because it expands. <u>Process Skills</u> <u>Emphasized</u> Observing, hypothesizing, quantifying	amount of the red ink from the other small jar into the large jar of cold water. What happens to the red ink? Make a model.				
<u>Subconcept #18</u> Water is a component of all organisms. <u>Process Skills</u> <u>Emphasized</u> Observing, formulating hypotheses	1. Put an apple and a potato in a plastic bag. Weigh both the apple and the potato separately. Cut up the apple and potato into small pieces and place each in a small pan open to the air. Weigh each every day for three days and record the weight each day. What is the weight loss from each? What did both the apple and potato lose and where did it go?	T47- 49			
	1. Mix about an inch of garden soil in a quart jar of water. Let it stand for a while. What happens to the soil particles? Place some cotton in a funnel and put about an inch layer	T49- 50			

Activities and Investigations Instructional Materials

		C.I.S.	S.M.A.	S.T.W.	MEDIA
of sand over the cotton. Put the funnel in a clean beaker. Slowly pour some water from the settling jar into the funnel. What happens to the water in the funnel? <u>Subconcept #19</u> Water supply is the result of the cycle of evaporation and condensation. <u>Process Skills</u> <u>Emphasized</u> Observing, inferring, hypothesizing, formulating models	1. Put 2 or 3 inches of rich soil into a large jug. Lower several tropical plants into the jug and anchor them into the soil. Water well and cork the top. What happens each afternoon?	T50-52			

GRADE V

CONCEPTUAL SCHEME A

When energy changes from one form to another, the total amount of energy remains unchanged.

SUGGESTED MATERIALS AND EQUIPMENT

equal arm balances, paper cups, spoons, weights, balloons, soda straws, wire, medicine droppers, string, marbles, elastic bands, rulers, thumb-tacks.

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Examples of Possible
Activities and Investigations Instructional Materials

		C.I.S.	S.M.A.	S.T.W.	MEDIA
<u>Concept #1</u> Energy must be applied to produce an unbalanced force, resulting in motion or change of motion. <u>Subconcept #1</u> To move an object, energy must be applied to overcome the pull of gravitation. <u>Process Skills Emphasized</u> Formulating hypotheses, predicting <u>Subconcept #2</u> Energy must be supplied to develop a force sufficient to overcome gravitational pull.					B <i>How Gravity Works</i> B <i>How Do Jets Fly</i> J.H. B <i>Rocket Power for Space Travel</i> J.H. B <i>The Earth As a Planet</i> N.E.B. B <i>Space Travel 2000</i> A.D. S.V.E. B <i>The Earth and Its Motions</i> Eye Gate B <i>What Are Space Stations?</i> J.H. B <i>Our Neighbor The Moon</i> J.H. B <i>Our Earth is Moving Curr.</i>
	1. Set a paper cup on one pan of an equal arm balance, and a weight on the other. With a spoon, put enough sand in the cup to make it balance the weight. Take off the weight. What happens to the cup of sand? Why? 2. Put strings through the sides of a paper cup. Lift the cup of sand with a spring balance. How much of a pull is needed to act against the force of gravitation?	T52		T275	

Examples of Possible
Activities and Investigations Instructional Materials

		C.I.S.	S.M.A.	S.T.W.	MEDIA
<u>Process Skills</u> <u>Emphasized</u>					
Formulating hypotheses, interpreting data, results	1. Blow up a long balloon, and then tape a soda straw lengthwise to the balloon. Pass a thin wire through the ends to two chairs. What will happen if the air is released? In which direction does the balloon move? Why?(theory)	T54	T53	T273	☐ <i>The Solar System</i> E.B.F. ☐ <i>Exploring The Moon</i> J.H. ☐ <i>Getting Ready For a Space Trip</i> J.H.
Experimenting, formulating models	2. Make a model rocket by taking a long balloon, inserting a glass medicine dropper into the mouth of the balloon, blowing it up and tying it with a string. Fasten a paper cone to the top of the balloon. After leaning the model against books, loosen the string. Why didn't the rocket keep moving forward?				✎ <i>How Gravity Affects Us</i> E.B.F. ✎ <i>A Trip to the Moon</i> E.B.F.
<u>Subconcept #3</u> To alter the path of a body in space, energy must be applied to affect the relationship between gravitational pull and centrifugal force. <u>Process Skills</u> <u>Emphasized</u>					☐ <i>Our Solar System</i> S.V.E. ☐ <i>Space Satellites</i> J.H. ☐ <i>Gravity</i> McGraw-Hill ☐ <i>Man's Preparation For Space Travel</i> J.H.
Predicting, formulating hypotheses	1. Push a marble off the edge of a desk or table. What path does the marble take?	T56		T279	

Examples of Possible
Activities and Investigations Instructional Materials

		C.I.S.	S.M.A.	S.T.W.	MEDIA
Quantifying, interpreting data, communicating	Can you change the shape of the marble's path? Which takes the longest to fall if the marble is pushed off with little force or great force? 2. Mark off a scale in inches on your desk with a piece of chalk. Release marbles at different distances from your elastic band sling. Measure the distances the marbles travel. Make a graph of your results.				☐ <i>Earth's Nearest Neighbor</i> S.V.E. ☐ <i>The Sun and Its Family</i> S.V.E. ☐ <i>Man Becomes An Astronomer</i> Walt Disney ☐ <i>How Man Explores Space</i> S.V.E.
<u>Subconcept #4</u> Inertia and gravitation affect the path of bodies travelling in space. <u>Process Skills</u> <u>Emphasized</u> Formulating models	1. Make a model solar system. Suggested scale: 9" = 8,000 miles. Circles: Sun - 9", Earth - 1", Mercury - 3/8", Mars and Pluto - 1/2", Uranus and Neptune - 4", Saturn - 9 1/2", Jupiter - 11", Venus - 8". Why do the earth and the other planets orbit the sun? Why don't the planets fall into the sun?	T59	T69		

Examples of Possible
Activities and Investigations Instructional Materials

		C.I.S.	S.M.A.	S.T.W.	MEDIA
Predicting, interpreting data	2. Insert two thumbtacks into a paper an inch or two apart. After putting a string loop around the thumbtacks, put a pencil inside the loop, tighten the string and draw a line. What shape is the orbit? How will the shape of the path change if you move the tacks further apart? What kind of orbit do you think the earth makes?				
Interpreting data, formulating hypotheses	3. Divide the students into groups having each group do library research on a particular planet or planets. Study photo-copied photographs that astronomers have taken of the planets. See what can be hypothesized from the photographs and then call upon the "resource group" (the group who studied the particular planet) to report on what astronomers have concluded about the planet.				
Subconcept #5 Exploration of the moon depends upon understanding of how the position and motion of bodies in space are affected by gravitation and inertial motion.					

Examples of Possible
Activities and Investigations Instructional Materials

		C.I.S.	S.M.A.	S.T.W.	MEDIA
<u>Process Skills</u> <u>Emphasized</u> Predicting, interpreting data	1. Attach a yardstick with a hole in the top vertically to a chair. Drill a hole in the center of another yardstick and attach it to the vertical yardstick. To the end of the horizontal yardstick, attach a plastic sheet marked off in one-inch squares, and then aim it at the moon so that the moon seems to be sitting on the end of the yardstick. Wait for five minutes and then look along the stick. Has the moon moved? How do you know?	T61	T59		
<u>Subconcept #6</u> Exploration of the moon depends upon understanding of how the position and motion of bodies in space are affected by gravitation and inertial motion.					
<u>Process Skills</u> <u>Emphasized</u> Formulating hypotheses, defining terms, formulating models	1. You are a group of astronauts who are going to take a trip to the moon. How would you go about solving these problems?	T63	T69	T286	

Examples of Possible
Activities and Investigations Instructional Materials

		C.I.S.	S.M.A.	S.T.W.	MEDIA
Interpreting data and results	Weightlessness; G forces; Food in space; water; danger from light; landing on the moon; returning to earth; and clothing you will wear. 2. Study photographs of the moon's surface (Hills, valleys, craters and "bumps"). Will the surface affect the landing or launching of the spacecraft? What do you think it would feel like to walk on the moon? Do you see any other problems that astronauts may have?				

CONCEPTUAL SCHEME B

When matter changes from one form to another, the total amount of matter remains unchanged.

SUGGESTED MATERIALS AND EQUIPMENT

glass funnel, perfume, balloons, string, beakers, vanilla extract, chlorine water (bleach), mercuric oxide, pyrex test tubes, test-tube clamps, alcohol lamps, sugar, steel wool, vinegar, trays, iron, sulfur, magnets, litmus paper (red and blue), ammonia, limewater, rubber tubing, flasks, tincture of iodine, soda straws, potted plant, transplant plastic, styrofoam balls, toothpicks, flashbulbs (used and new).

RECOMMENDED REFERENCES

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 S.T.W. - *Science for Tomorrow's World* (Collier, Macmillan)

Code for Media:

- ⌂ Films
- ⌂? Film Loop
- ⌂ Filmstrip
- ⌂ Records
- ⌂ Tapes
- [] Slide or Transparencies

NOTE: Top of pages are marked according to grade, conceptual scheme and concept number.

Examples of Possible
Activities and Investigations Instructional Materials

		C.I.S.	S.M.A.	S.T.W.	MEDIA
<u>Concept #1</u> In chemical and physical change, the total amount of matter remains unchanged. <u>Subconcept #1</u> A molecule is the smallest particle of a substance which retains the properties of the substance. <u>Process Skills Emphasized</u> Formulating hypotheses, defining terms	1. Using a funnel place a few drops of perfume in a balloon. Blow up the balloon, and firmly tie a knot in its neck so that no air can escape. Smell the air in a large beaker. Place the balloon in the beaker letting it stand for 15 minutes. Remove the balloon from the beaker. Smell the air in the beaker. What do you smell? How could perfume get into the air in the beaker from inside the balloon?				☐ <i>What Things Are Made Of</i> S.V.E. ☐ <i>Atoms and Molecules</i> S.V.E. ☐ <i>Chemical Changes</i> S.V.E. ☐ <i>Earth, A Great Storehouse</i> S.V.E. ☐ <i>Chemical Changes</i> McGraw-Hill ▶ <i>Atomic Energy - Inside the Atom</i> E.B. ▶ <i>Explaining Matter: Chemical Change</i> E.B.
Controlling variables	2. Pour a large spoonful of vanilla extract or chlorine water into separate glasses. Insert a balloon or plastic bag about one-	T28		TL68	▶ <i>8 Break-down of Mercuric Oxide</i>

Examples of Possible
Activities and Investigations Instructional Materials

		C.I.S.	S.M.A.	S.T.W.	MEDIA
	third of the way into each glass or jar, and inflate the balloon so that it is wedged tightly into the opening to prevent the odors from escaping. Balloons should be tied with string, using a slip knot. In a third empty glass, inflate a balloon with air. Allow the investigation to stand for two or three days. Then unseal each balloon, smelling the air as it escapes. How did the odors get inside? Why couldn't you smell anything in the glass where there was no perfume or chlorine water?				
<u>Subconcept #2</u> Compounds can be broken down into the elements of which they are composed. <u>Process Skills</u> <u>Emphasized</u> Interpreting data, defining terms, inferring Formulating hypotheses, inferring	1. Heat mercuric oxide in a pyrex test tube. DON'T BREATHE IN THE FUMES. What happens? Explain. 2. Place a glowing splint into the test tube. What happened? What is your theory? Heat sugar in a test tube. What do you see? What do you think has happened?	T31		T196	

Examples of Possible
Activities and Investigations Instructional Materials

		C.I.S.	S.M.A.	S.T.W.	MEDIA
<u>Subconcept #3</u> Compounds are built up from elements. <u>Process Skills Emphasized</u> Formulating hypotheses, interpreting data, experimenting Formulating models	1. Roll steel wool into one-inch balls and put into vinegar for about 6 hours. Rinse with water. Place a ball of steel wool into the bottom of a test tube and invert in a tray of water. Invert another test tube with steel wool into a tray containing no water. Leave for 2 or 3 days. What happens? Why? 2. Place iron and sulfur together in a test tube and heat over a hot flame. Observe what happens. Test the substance with a magnet. What reasons can be given for the change after heating?	T33	T50	T193	
<u>Subconcept #4</u> Compounds are grouped by their chemical properties. <u>Process Skills Emphasized</u> Formulating hypotheses	1. Distribute strips of red and blue litmus and construction paper. Drop vinegar and household	T35		T179	

Examples of Possible
Activities and Investigations Instructional Materials

		C.I.S.	S.M.A.	S.T.W.	MEDIA
Interpreting data, defining terms, classifying	ammonia on the paper strips. What happens to the litmus paper? What happens to the construction paper? Why do you think this is so? 2. Collect the following materials: lemon juice, salt water, washing soda, water, cooking oil, fresh milk, sour milk, sugar water, carbonated soft drink. Test the solutions with red and blue litmus paper. Make a chart showing how we could group these materials.				
<u>Subconcept #5</u> Chemical reactions are a dependable means of testing the presence of a substance. <u>Process Skills</u> <u>Emphasized</u>					
Formulating hypotheses	1. Place some carbonated soft drink in a glass and add limewater to it. What happens? What does this show us?	T38		T179	
Interpreting data	2. Place about an inch of eggshells in the bottom of a flask. Pour vinegar into the flask until it is about three-quarters full. What happens? What				

Examples of Possible
Activities and Investigations Instructional Materials

		C.I.S.	S.M.A.	S.T.W.	MEDIA
Formulating hypotheses	is forming? Do you see something being changed? Attach a delivery tube to the flask and collect the gas in test tubes that have been filled with water. Pour some limewater into a test tube full of the collected gas, and then shake it. What happens to the limewater? 3. Fill two jars with the same amount of water. Add a teaspoonful of corn-starch to one of the jars. A few drops of tincture of iodine should now be added to each jar. What happens? Test other substances for iodine e.g. iodized salt, sea foods.				
<u>Subconcept #6</u> The production of carbon dioxide is evidence of oxidation within living things. <u>Process Skills</u> <u>Emphasized</u> Formulating hypotheses	1. Pour limewater into a glass to the height of about one inch. Exhale through a soda straw into the limewater. What happens to the limewater? What does this tell us about air we exhale?	T40	T507	T297	

Examples of Possible
Activities and Investigations Instructional Materials

		C.I.S.	S.M.A.	S.T.W.	MEDIA
Controlling variables, interpreting data	2. Seal a potted plant, e.g. geranium and a dish of limewater in transparent plastic. Seal only a dish of limewater in another plastic bag. What do you think will happen? Have children observe their experiment every day. Did anyone notice any difference in their experiment today? What have you learned about a geranium plant? Do you think this is true of all plants?				
Interpreting data	3. Get some mealworms from a pet shop and place them on a piece of paper that is wedged into the top of a vial containing some bromothymol blue solution. Cap the vial. What happened? (Solution turned yellow) Why?				
<u>Subconcept #7</u>					
The earth's matter is built up of atoms combined in many ways.					
<u>Process Skills</u> <u>Emphasized</u>					
Experimenting	1. Collect some common substances e.g. salt, coal, copper wire, iron ore, sulfur, lead, mica. Examine the substances. What are they made of?	T42		T190	

Examples of Possible
Activities and Investigations Instructional Materials

		C.I.S.	S.M.A.	S.T.W.	MEDIA
Formulating models	2. Using different sized styrofoam spheres and toothpicks construct models of various substances e.g. water, iron oxide, carbon dioxide.				
<u>Subconcept #8</u>					
In oxidation, matter is neither gained nor lost.					
<u>Process Skills</u> <u>Emphasized</u>					
Interpreting, experimenting	1. Get two unused flashbulbs of the same size. Balance the flashbulbs on an equal arm balance. Remove one of the flashbulbs gently from the scale, insert it into a camera and snap the shutter. Put the used flashbulb back on the scale. Does the weight of the flashbulb change after it has been used? How can you tell?	T45	T51	T170	
Formulating hypotheses, interpreting data	2. Put some moist steel wool into a test tube. Cap the tube tightly. Balance the tube on an equal arm balance. Leave the tube standing on the balance for several days. Is there now more or less substance in the test tube? How do you know?				

GRADE V

CONCEPTUAL SCHEME C

Living things are interdependent with one another and with their environment.

SUGGESTED MATERIALS AND EQUIPMENT

water plants (e.g. elodea), glass funnels, test tubes, matches, splints of wood, jars and tops, black paper, alcohol, iodine solution, adhesive tape, microscopes, indicator dye (bromothymol blue or methyl orange), glasses, pieces of cardboard, corks, animal cage, animals (mice, hamsters or guinea pigs), pieces of coal, (preferably with plant fossils showing), aluminum foil, cotton, wool, onions, glass slides, cover slips, eyedroppers, toothpicks.

RECOMMENDED REFERENCES

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Examples of Possible
Activities and Investigations Instructional Materials

		C.I.S.	S.M.A.	S.T.W.	MEDIA
<u>Concept #1</u> The capture of radiant energy by green plants is basic to the growth and maintenance of all living things. <u>Subconcept #1</u> During photosynthesis (the manufacture of carbohydrates), green plants produce oxygen. <u>Process Skills Emphasized</u> Formulating hypotheses, interpreting data, making operational definitions	1. Put a bunch of water plants, e.g. elodea, and water into a glass. Cover the plants with an inverted funnel, making sure that the top of the funnel does not extend beyond the surface of the water. Insert a test tube filled with water over the small end of the funnel. Place the whole set-up in a sunny place for a day. What has happened in the test tube? What is the gas that is in the test tube? Any suggestions as to how you can test it? (Inserting a glowing splint into the tube) Now, can you explain why we keep green plants in an aquarium?	T114	T88	T296	☐ <i>Dependent Plants</i> Harper and Row ☐ <i>Photosynthesis</i> GB Instructional ☐ <i>The World of Living Things</i> Harper and Row

Examples of Possible
Activities and Investigations Instructional Materials

		C.I.S.	S.M.A.	S.T.W.	MEDIA
Controlling and manipulating variables, interpreting data	2. What do you think will happen if you put water into two jars, place a water plant in one jar, and put a snail into both jars? Seal the jars and watch them for a week or two. What happens in each jar? Can you explain why?				
<u>Subconcept #2</u>					
During photosynthesis, green plants manufacture simple sugars and starches, using the energy left.					
<u>Process Skills Emphasized</u>					
Formulating hypotheses, making operational definitions	1. Fold a piece of black paper closely around a geranium leaf and fasten with a paper clip. Cover half of another leaf with black paper. Set the plant in the sunlight for about 3 days. Remove the chlorophyll from the leaves by shaking them in a jar of warm alcohol. Now test the leaves for starch with an iodine solution. How does the iodine show if starch is present? In which of the leaves is there starch? Why is this so?	T116			
Formulating hypotheses, interpreting data	2. Obtain leaves that are partly green and partly white. Test the leaves for				

Examples of Possible
Activities and Investigations Instructional Materials

		C.I.S.	S.M.A.	S.T.W.	MEDIA
starch using the same procedure as outlined above. Did any of the white parts turn blue-black from the iodine? Did any of the green portions turn blue-black? How can you explain this? <u>Subconcept #3</u> Green plants make carbohydrates from carbon dioxide and water; animals are dependent on green plants for their food. <u>Process Skills</u> <u>Emphasized</u> Formulating hypotheses Controlling and manipulating variables, interpreting data and results	1. Make an aquarium in a large jar by sealing in pond water, water plants and sand. Wind adhesive tape around the cap and jar so air cannot get in or out. Place the jar where there is a moderate amount of sunlight. Observe the plants from day to day. Are they growing or dying? Why? Examine the water under a microscope, and maybe this will help us in coming up with a reason. 2. Get three empty jars with self-sealing tops. Put water in all three jars, water plants in two jars and a good-sized snail in	T118	T87		

Examples of Possible
Activities and Investigations Instructional Materials

		C.I.S.	S.M.A.	S.T.W.	MEDIA
Formulating hypotheses, interpreting data and results	one of the jars with water plants in it. Put a few drops of indicator dye (bromothymol blue, methyl orange) in each bottle and then seal each jar tightly. Observe for several days. What happens in each of the jars? What does the change of color indicate? Does the snail give off carbon dioxide? Which plant looks healthier? 3. Fill two glasses with water. Obtain two pieces of cardboard, make a hole in the middle of each, and then place the cardboards over the glasses. Put the stem of a leaf (e.g. geranium) through the hole in one of the pieces of cardboard. Invert two other glasses over the pieces of cardboard. After a few hours what do you see inside the glass that contains the leaf? Try to explain what the leaf is doing with the water. We might possibly learn something more if we examine a leaf carefully under a microscope.				

Examples of Possible
Activities and Investigations Instructional Materials

		C.I.S.	S.M.A.	S.T.W.	MEDIA
<u>Subconcept #4</u> Living things obtain from one another and from the environment the matter and energy they need for growth and activity. <u>Process Skills Emphasized</u> Experimenting	1. Let us try to make a test-tube world for one small snail. It will be up to you to decide what should be put in the test-tube with the snail. After you have placed what is needed in the tube, seal the tube with a cork, and then select a place to keep your tube. Observe your tube for several days. Were all the snail's needs met? If not, write down what you think is necessary and try to explain why you think it is needed.	T121	T88		
Experimenting	2. Catch several insects (e.g. grasshoppers) and make a home for them in a glass jar. Put whatever material you think is necessary in the jar. Place the jar in a suitable place and observe for several days. Did your insects have all that they				

Examples of Possible
Activities and Investigations Instructional Materials

		C.I.S.	S.M.A.	S.T.W.	MEDIA
<u>Subconcept #5</u> Green plants are a basic source for many substances needed by all animal life. <u>Process Skills</u> <u>Emphasized</u> Controlling and manipulating variables, interpreting data and results	needed in their home? Can you think of ways in which the insects' environment can be improved?				
<u>Subconcept #6</u> Man, like all other living things is dependent on his environment - on all the matter and living things in it. <u>Process Skills</u> <u>Emphasized</u> Controlling and manipulating variables. formulating models	1. Divide a number of hamsters mice or guinea pigs into two groups. Design menus including green plants in one group's menu and no green plants in the other group's menu. Continue the experiment over a period of several weeks. What changes do you notice in each group of animals? Try to explain what has happened. 1. You are an astronaut who is going on a trip to the moon. What essential	T123 T125		T295 T315	

Examples of Possible
Activities and Investigations Instructional Materials

		C.I.S.	S.M.A.	S.T.W.	MEDIA
Formulating hypotheses, formulating models	parts of your environment must you take with you if you leave the land environment in a space capsule? 2. A deep sea diver is getting ready to dive into the ocean to a depth of 300 feet. Will the environment in the ocean be different? How is the diver going to prepare himself for the new environment?				
<u>Subconcept #7</u> Interdependence of living things with their environment is related to the transformation of matter in a chemical change. <u>Process Skills Emphasized</u>					
Formulating hypotheses, interpreting data	1. Can you burn stored sunlight? Obtain chunks of coal and examine them carefully. How do we know coal is a fossil plant? How did these fossils capture and store energy?	Tl26			
Formulating hypotheses, formulating models	2. What do you think will happen to wood chips if we heat them in a flask? Try the investigation. What does this tell us about the formation of coal?				

Examples of Possible
Activities and Investigations Instructional Materials

		C.I.S.	S.M.A.	S.T.W.	MEDIA
Interpreting data, formulating models	3. Rapidly pump up a play-ground ball. What happens? Do you think this tells us something about coal and oil formation?				
<u>Subconcept #8</u>					
Plant and animal cells change matter as they interchange matter and energy with the environment.					
<u>Process Skills</u> <u>Emphasized</u>					
Making operational definitions	1. Line a plate with aluminum foil. First burn a piece of cotton and then a piece of wool in the plate. What difference do you notice in burning wool and burning cotton? How would you explain this difference in odor? What is the substance that is left over after burning?	T128		T31	
Formulating models	2. Pull a thin layer of onion skin off an onion, place a piece on a slide and stain it with iodine. Look at the slide, under a microscope. Draw a picture of what you see. Now make an epithelial cell slide. Scrape the inside of your cheek with the flat part of a toothpick smearing the contents on a slide. Stain with iodine. Draw a picture of what you see. In what ways are the onion cell and epithelial cell different? Why is there a difference?				

GRADE VI

CONCEPTUAL SCHEME A

When energy changes form one form to another, the total amount of energy remains unchanged.

SUGGESTED MATERIALS AND EQUIPMENT

blocks, spring balance, support, string, weights, pulley, block and tackle, chisel, wedge, screwdriver, nuts and bolts, screws, meat grinder, charts showing machines, egg beater, sandpaper, wax paper, aluminum foil, machine oil, empty can, miniature 4 wheel cart, alcohol lamp, balloon, test tube, stopper, container (water), 2 apples, ping-pong balls, funnel, plastic bag, glass rods, ebony rods, compass, silk, cat's fur, model of an atom and molecule, magnet (strong and weak), coils (insulated wire), galvanometer, plastic tube, dry cell battery, bulb and socket, model of a motor, charts on electricity, equipment to make a bell and motor, telegraph model, telephone model, iron filings, tuning forks.

SUPPLEMENTARY REFERENCES

Machines, Life - Time, p. 172 - 179.

A Source Book for Elementary Science, p. 373 - 393.

RECOMMENDED REFERENCES

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S.M.A. - *Science, A Modern Approach* (Holt, Rinehart)
S.T.W. - *Science for Tomorrow's World* (Collier, Macmillan)

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		C.I.S.	S.M.A.	S.T.W.	MEDIA
<u>Subconcept #3</u>					<i>B Rocket Power For Space Travel J.H.</i>
Pulley systems both change the direction of the force and multiply it.					<i>B What Is Static Electricity J.H.</i>
<u>Process Skills</u> <u>Emphasized</u>					<i>B What Is Current Electricity J.H.</i>
Quantifying, observing, experimenting	1. Use various numbers and combinations of pulleys to lift a standard weight.	T81			<i>B How Most Electricity Is Produced J.H.</i>
<u>Subconcept #4</u>					<i>B Producing Small Amounts of Electricity J.H.</i>
Most machines are combinations or modifications of a few simple machines.					<i>B Electro-magnets and How They Work J.H.</i>
<u>Process Skills</u> <u>Emphasized</u>					<i>B How Electricity Is Used In The Homes J.H.</i>
Quantifying, predicting, hypothesizing, observing	1. Use an inclined plane of varying slopes to help a load.	T83			<i>B Using Electricity Safely J.H.</i>
	2. Experiment with wheels and axles to discover how they can multiply force, change direction, and increase speed.	T84			<i>B Inclined Planes At Work J.H.</i>
Observing, classifying, communicating, formulating models, observing	3. Students can look for simple machines in small motors, toys, and other complex machines. They can use these principles to construct complex machines of their own.				

Examples of Possible
Activities and Investigations Instructional Materials

		C.I.S.	S.M.A.	S.T.W.	MEDIA
<u>Subconcept #5</u>					□ <i>The Work of Gears</i> S.V.E.
Friction increases effort that must be applied and decreases speed, (distance).					□ <i>Machines In Action</i> S.V.E.
<u>Process Skills</u> <u>Emphasized</u>					□ <i>The Work of the Lever</i> S.V.E.
Observing, quantifying	1. Have students rub their hands together then use water, oil, soap, sandpaper, etc. between their hands.				□ <i>The Work of the Wheel and Axle</i> S.V.E.
Quantifying, predicting, experimenting	2. An Investigation Examine the sandpaper with a magnifying glass. Examine the wax paper with a magnifying glass. Trace the energy changes involved in this investigation.	181	89		□ <i>The Work of the Pulley</i> S.V.E. □ <i>Work and Friction</i> J.H.
<u>Subconcept #6</u>					□ <i>Elements, Compounds and Mixtures</i> S.V.E.
Work is done only when an object is moved through a distance.					□ <i>Atoms, Molecules, Ions</i> S.V.E.
<u>Process Skills</u> <u>Emphasized</u>					
Observing, quantifying, experimenting	1. An Investigation	185			□ <i>Understanding Electricity</i> J.H.
	2. Compare effort and distance of a single fixed pulley to that of a block and tackle.				□ <i>What Is Magnetism</i> J.H.

Examples of Possible
Activities and Investigations Instructional Materials

		C.I.S.	S.M.A.	S.T.W.	MEDIA
<u>Subconcept #7</u> The energy of moving molecules of air and water provide a force that can be harnessed to do work. <u>Process Skills</u> <u>Emphasized</u> Observing, quantifying, formulating models, experimenting	3. Blow through a drinking straw on to a styrofoam ball which is at rest. What happens? If the ball is coming toward you when you blow on it how is its motion altered? If the ball is moving across the table and you blow on it from the side how does it move?				⊞ <i>Magnetic Fields</i> J.H. ⊞ (16 mm) ⊞ <i>Energy and Work</i> E.B.F. ⊞ <i>What Is Uniform Motion</i> E.B.F. ⊞ <i>Molecules in Motion</i> E.B.F.
	1. Demonstration	196		49	
	2. An Investigation	199			
	3. Demonstration	201			
<u>Subconcept #8</u> Molecules may be given kinetic energy in a chemical change. <u>Process Skills</u> <u>Emphasized</u> Observing, hypothesizing	1. An Investigation	207			
	2. Lay a metal plate on a tripod stand and heat it. Now wrap the head of a				

Examples of Possible
Activities and Investigations Instructional Materials

		C.I.S.	S.M.A.	S.T.W.	MEDIA
<u>Subconcept #9</u> Differences in pressure result in a force acting in the direction of the lower pressure. <u>Process Skills Emphasized</u> Observing, quantifying, predicting, experimenting					
	1. Blow across the top of a sheet of paper.				
	2. An Investigation	213			
	3. Spool and straw on card-board	217			
<u>Subconcept #10</u> An increase in kinetic energy can produce an unbalanced force. <u>Process Skills Emphasized</u> Observing, predicting, experimenting					
	1. Blow up a balloon and let it go.				
	2. Throw a ball while standing on roller skates.				
	3. Charge two balloons by rubbing them with wool and hang them on nylon threads. What happens if you bring the balloons together? As you push them together you are using energy. It is stored as electric (potential energy). When you release the balloons they fly apart. (kinetic energy)				

Examples of Possible
Activities and Investigations Instructional Materials

		C.I.S.	S.M.A.	S.T.W.	MEDIA
<u>Subconcept #11</u> A transfer of electrons from one object to another gives them potential energy; when the electrons move they have kinetic energy. <u>Process Skills Emphasized</u> Observing, quantifying, experimenting	1. Vulcanite and glass rods, and fur and silk demonstrate transfer of electrons.				
<u>Subconcept #12</u> The energy obtained from moving electrons is never greater than the energy put into making the electrons move through the circuit. <u>Process Skills Emphasized</u> Observing, quantifying, predicting	1. Make electromagnets 2. An Investigation 3. An Investigation	237 239			
<u>Subconcept #13</u> The energy of moving electrons can be used to do work.					

Examples of Possible
Activities and Investigations Instructional Materials

		C.I.S.	S.M.A.	S.T.W.	MEDIA
<u>Process Skills</u> <u>Emphasized</u>					
Formulating models, experimenting	1. Make electric bells, motors, telegraph, etc.				
<u>Subconcept #14</u>					
Sound waves may be converted into varying strengths of electric current, transferred through a conductor, and reconverted into sound waves.					
<u>Process Skills</u> <u>Emphasized</u>					
Interpreting data, formulating models, experimenting, observing	1. An Investigation	259			
	2. An Investigation	263			
	3. An Investigation	265			
<u>Subconcept #15</u>					
Electric energy can be changed to electro- magnetic waves that can carry signals through space at the speed of light.					
<u>Process Skills</u> <u>Emphasized</u>					
Observing, inferring	1. An Investigation	269			
	2. Demonstration	T127			

GRADE VI

CONCEPTUAL SCHEME B

When matter changes from one form to another, the total amount of matter remains unchanged.

SUGGESTED MATERIALS AND EQUIPMENT

sulfur, styrofoam balls, wire, marbles, modelling clay, sugar cubes, toothpicks, shoe box, dominoes, pencils.

SUPPLEMENTARY REFERENCES

Canadian Newstime, Vol. 4 No. 5, March, 1967.
Shaw, *About Atomic Power*, Radlauer, 1967.
Kahn, *The Peaceful Atom*, Prentice-Hall, 1963.
Reuben, *What Is An Atom*, Benefic Press, 1960.

RECOMMENDED REFERENCES

Code: C.I.S. - *Concepts in Science* (Longmans)
S.M.A. - *Science, A Modern Approach* (Holt, Rinehart)
S.T.W. - *Science for Tomorrow's World* (Collier, Macmillan)

Code for Media:

- ⏮ Films
- ⏮⏮ Film Loop
- ⏮ Filmstrip
- ⏮ Records
- ⏮ Tapes
- [] Slide or Transparencies

NOTE: Top of pages are marked according to grade, conceptual scheme and concept number.

Examples of Possible
Activities and Investigations Instructional Materials

		C.I.S.	S.M.A.	S.T.W.	MEDIA
<u>Concept #1</u> In nuclear reactions, a loss of matter is a gain in energy; and the sum of the matter and energy remain unchanged. <u>Subconcept #1</u> Each different atom consists of particles arranged in its own characteristic structure. <u>Process Skills Emphasized</u> Observing, interpreting data, experimenting, formulating models					B <i>The Atom</i> McGraw-Hill B <i>Molecules, Atoms, Simple Reactions</i> E.B.F. B <i>The Composition of Atoms</i> E.B.F. B <i>Atoms and Molecular Weights</i> E.B.F. B <i>Molecules in Motion</i> E.B.F. B <i>Atoms, Molecules and Ions</i> S.V.E. B <i>Atoms and Molecules</i> S.V.E.
<u>Subconcept #2</u> When the nucleus of the atom changes, energy is released. <u>Process Skills Emphasized</u> Formulating models, experimenting, communicating	1. Research and report on Rutherford, Currie, Bohr and Dalton. 2. Examine a piece of sulfur and powdered sulfur. 3. Construct models of atoms using styrofoam balls and wire.	286	6	113	B <i>Atoms and Molecules</i> S.V.E. B <i>Atomic Energy Inside the Atom</i> E.B.F. B <i>Evidence for Molecules and Atoms</i> E.B.F.
	1. Using marbles to make an atomic model, then shoot in another marble to "split" the atom.	295	71	101	

Examples of Possible
Activities and Investigations Instructional Materials

		C.I.S.	S.M.A.	S.T.W.	MEDIA
<u>Subconcept #3</u> Energy can be released by fission of atomic nuclei; the rate of fission can be controlled. <u>Process Skills</u> <u>Emphasized</u> Interpreting data, formulating models	2. Demonstration	T-139			☞ <i>Atom Smashers</i> E.B.F.
	3. Show pictures of a cyclotron and of an atomic reaction.		72		
	4. Discuss the uses of atomic reactions.		75		[] <i>The Atom K.E. Master Book</i> for Diazo copies
<u>Subconcept #4</u> Nuclear energy can be harnessed to machines to develop other forms of energy to do work. <u>Process Skills</u> <u>Emphasized</u> Communicating, interpreting data	1. Demonstration	303			
	2. Report on Chalk River reactor and other such projects.		75		
	3. Build a model of a nuclear reactor.	306			
	1. Report on uses of nuclear energy. e.g. Power stations, submarines, medical uses, etc.	308	78		
	2. How is nuclear energy changed to other forms?				

GRADE VI

CONCEPTUAL SCHEME C

Living things are interdependent with one another and with their environment.

SUGGESTED MATERIALS AND EQUIPMENT

styrofoam balls, seeds, gold fish or salamander, several lengths of rope, vacuum bottle, tin can, samples of metals, samples of man made fibers, Petri dishes, cotton swabs, mold, spores, microscopes, gelatin, bouillon cube.

SUPPLEMENTARY REFERENCES

McCullar, Bernice, *How to Study and Why*, Available from: 3328 Lakeside Cres. S.W.Cal.(2 long play records).
A Fleck of Mold, p. 219.
New Worlds, Ginn.

RECOMMENDED REFERENCES

Code: S.M.A. - *Science, A Modern Approach* (Holt, Rinehart)
C.I.S. - *Concepts in Science* (Longmans)
S.T.W. - *Science for Tomorrow's World* (Collier, Macmillan)

Code for Media:

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-  Slide or Transparencies

NOTE: Top of pages are marked according to grade, conceptual scheme and concept number.

Examples of Possible
Activities and Investigations Instructional Materials

		C.I.S.	S.M.A.	S.T.W.	MEDIA
<u>Concept #1</u>					
Living things are adapted by structure and function to their environment.					☐ Atoms, Molecules, Ions ☐ Behavior of Living Things Y.A.F. ☐ How Heat Causes Expansion J.H.
<u>Subconcept #1</u>					
Behavior may be inborn and involuntary.					
<u>Process Skills</u> <u>Emphasized</u>					
Experimenting, observing, predicting	1. Gently throw crumpled paper or styrofoam balls at the eyes of a person who is protected by a pane of glass. Did he learn to blink or was it an involuntary action? 2. Plant seeds up-side-down to see what happens.	T7			☐ Gregor Mendel E.B.F. ☐ Work of Louis Pasteur F.O.M. ☐ The Salk Vaccine P.S.P.
<u>Subconcept #2</u>					
Behavior consists of responses to changes (stimuli) in the environment.					▶◀ (16 mm) ▶◀ Anti- biotics E.B.F.
<u>Process Skills</u> <u>Emphasized</u>					
Investigation, predicting, inferring, experimenting	1. An investigation What is the stimulus? What is the response? 2. Train a fish, salamander, etc. to respond to a stimulus by using a	13			
		T9			

Examples of Possible
Activities and Investigations Instructional Materials

		C.I.S.	S.M.A.	S.T.W.	MEDIA
	reward system. How long does the response continue if the reward is discontinued? 3. Library research and report on Pavlov's experiments.				
<u>Subconcept #3</u> Habits and learning result from interaction of inherited structures with stimuli. <u>Process Skills</u> <u>Emphasized</u> Observing, communicating, hypothesizing, predicting	1. Teach students to tie a bowline knot. Do this several times and compare how long it takes each time. It becomes a learned automatic act. 2. Plan the steps one must go through to learn to ride a bicycle. 3. Students develop their own investigations to show good-insight learning.	T11 T14			• <i>How to Study and Why</i> Bernice McCullar Available from: 3328 Lake-side Cres. S. W. Calgary
<u>Subconcept #4</u> Learning is improved by the development of efficient habits of study.					

Examples of Possible
Activities and Investigations Instructional Materials

		C.I.S.	S.M.A.	S.T.W.	MEDIA
<u>Process Skills</u> <u>Emphasized</u> Inferring, predicting, hypothesizing, experimenting	1. Show how regular practice can aid in fixing a habit by dividing the group into 2 sections, one section writes each day for a given time with the left hand; the second practices only twice; compare the results after a given length of time.			329	
<u>Subconcept #5</u> Substances (minerals) in the earth's crust can be altered to produce new materials.					
<u>Process Skills</u> <u>Emphasized</u> Observing, classifying, communicating, predicting, interpreting data	1. Demonstrate the difference between a chemical and a physical change in an element. 2. An Investigation. Predict how Hall was able to get aluminum. 3. Report on processing aluminum and uses of aluminum.	T25 50 T24			

Examples of Possible
Activities and Investigations Instructional Materials

		C.I.S.	S.M.A.	S.T.W.	MEDIA
<u>Subconcept #6</u> Knowledge of the nature of heat has enabled man to develop new ways to modify and control his environment. <u>Process Skills Emphasized</u> Observing, predicting, hypothesizing	1. Have cold and hot water, add a couple of drops of ink to both containers. Watch it swirl around. Compare containers. Time taken to completely mix. 2. Examine a vacuum bottle. How does it keep things hot? How does it keep things cold? 3. From experiments and reading develop several concepts about heat and display in a chart form. Decide how these concepts apply to everyday situations.		31		
<u>Subconcept #7</u> Metals can be separated from their compounds; they can be combined to obtain new compounds having new properties.		T33		49	

Examples of Possible
Activities and Investigations Instructional Materials

		C.I.S.	S.M.A.	S.T.W.	MEDIA
<u>Process Skills</u> <u>Emphasized</u> Communicating, observing, experimenting, investigating	1. Discuss how early man lived and how metals were used for tools. 2. Discuss a hypothetical situation to bring out whether the tool or the concept came first. 3. Scratch a tin can, let it rust. Develop ideas about how to prevent rust. 4. Examine different metals to discover their properties. How can alloys be made? What are the uses of alloys?				
<u>Subconcept #8</u> Knowledge of molecular structure enables man to invent new fibers with improved proper- ties.			11		
<u>Process Skills</u> <u>Emphasized</u> Investigating, communicating, interpreting data	1. Student reports on the silkworm. 2. Discuss how man has tried to imitate this process. 3. Set up a display of samples of various man made fibers.	T35			

Examples of Possible
Activities and Investigations Instructional Materials

		C.I.S.	S.M.A.	S.T.W.	MEDIA
<u>Subconcept #9</u> Bacteria, plants without chlorophyll, depend on other organisms for their food. <u>Process Skills Emphasized</u> Hypothesizing, observing, experimenting, investigating	4. What are the special properties of these fibers?				
	1. An Investigation (Setting up bacteria cultures) What conditions favor the growth of bacteria? 2. Prepare cultures with swabs from cheek, glasses, hair, fingernails, desk, etc. Bacteria are everywhere. 3. Library research on kinds of bacteria.	101 T45			
<u>Subconcept #10</u> Nongreen plants without chlorophyll, depend on other organisms for their food. <u>Process Skills Emphasized</u> Investigating, observing, classifying	1. Grow bread mold. Examine under a microscope.	105	181		

Examples of Possible
Activities and Investigations Instructional Materials

		C.I.S.	S.M.A.	S.T.W.	MEDIA
<u>Subconcept #11</u> Organisms are structurally adapted for defence against hostile micro-organisms in their environment. <u>Process Skills Emphasized</u> Communicating, observing, hypothesizing, investigating	2. Plant spores from bread mold on proper culture and in Petri dish of water. Compare growth. 3. Examine different kinds of bacteria with a microscope.		175		
	1. Discuss the kind of cells that line the nose and throat. How are they important? 2. An Investigation 3. Library research on importance of white blood cells.	112			
<u>Subconcept #12</u> Micro-organisms interact with other living things and their environment. Man changes the environment of micro-organisms as he seeks to conquer disease.					

Examples of Possible
Activities and Investigations Instructional Materials

		C.I.S.	S.M.A.	S.T.W.	MEDIA
<u>Process Skills</u> <u>Emphasized</u>					
Experimenting, observing, interpreting data	1. Research on work of Sir Alexander Fleming. Story - <i>A Fleck of Mold</i> 2. Transfer some mold and some bacteria to a dish. Observe the results. 3. Research on antibiotics. What do they do? 4. Research on work of Louis Pasteur.		174		
<u>Subconcept #13</u>					
Viruses interact with other living things and their environment. Man changes the environment of viruses in seeking to conquer disease.					
<u>Process Skills</u> <u>Emphasized</u>					
Communicating, interpreting data	1. Discussion about common children's diseases. 2. Reports on causes of these diseases. 3. Consult local Health Department for resource speaker.	196			

Examples of Possible
Activities and Investigations Instructional Materials

		C.I.S.	S.M.A.	S.T.W.	MEDIA
<u>Subconcept #14</u> Modern technology uses concepts of science to free the environment of harmful micro-organisms. <u>Process Skills Emphasized</u> Formulating models, investigating, experimenting, observing	1. Set up model filtration plant. 2. Bulletin board display on how we attempt to keep our environment free of harmful micro-organisms. 3. Show chemical method of purifying water by adding a drop of bleach to a glass of pond water. Note the decrease of micro-organisms.				

SAFETY IN SCIENCE

All children must develop sensible attitudes in relation to taking safety precautions when working in science. Attitudes determine behavior and cannot be taught as abstractions but must be built from experiences they have. To teach safety is a prime responsibility of the school and through situations that fall within the range of a child's own experience safety attitudes and behaviors should be taught. Simple explanations of what not to do must be reinforced with reasons that children can understand. Since science requires active participation, the teaching of safety practices is essential. The best guide is the use of common sense by children and teachers; the best way to handle accidents is to prevent them.

Handling of Heat Sources

1. The one generally recurrent situation that involves an element of danger is the use of heat sources in the form of open flames. Students should be cautioned about the careful use of burners.
2. A fire extinguisher, a fire blanket, and a first aid kit should be readily available.

Handling Animals and Plants

1. Children should bring animals to the classroom only after they have received permission from the teacher.
2. Before a small animal is brought into the classroom for observation, plans should be made for proper habitat and food. The living quarters of animals in the classroom must be kept clean, free from contamination, and secure for the confinement of the animals. Plans should be made for animal care over the weekends and during vacation periods.
3. Acquaint children with the potential dangers involved in handling animals, certain plants, and bacteria.

Handling of Chemicals

Children should be cautioned about smelling, tasting or touching unknown chemicals before they have been told by the teacher that it is permissible.

Handling of Electrical Devices

1. Children should be shown how to insert and remove an electric plug from a socket.
2. At the beginning of investigations that involve electricity tell the children not to experiment with electricity at school or home unless an adult is present.

Handling Glassware

1. Either instruct children quite carefully on how to insert glass tubing into stoppers or do it yourself. (Hands should be kept close together.)
2. Dispose of broken or chipped glassware.

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